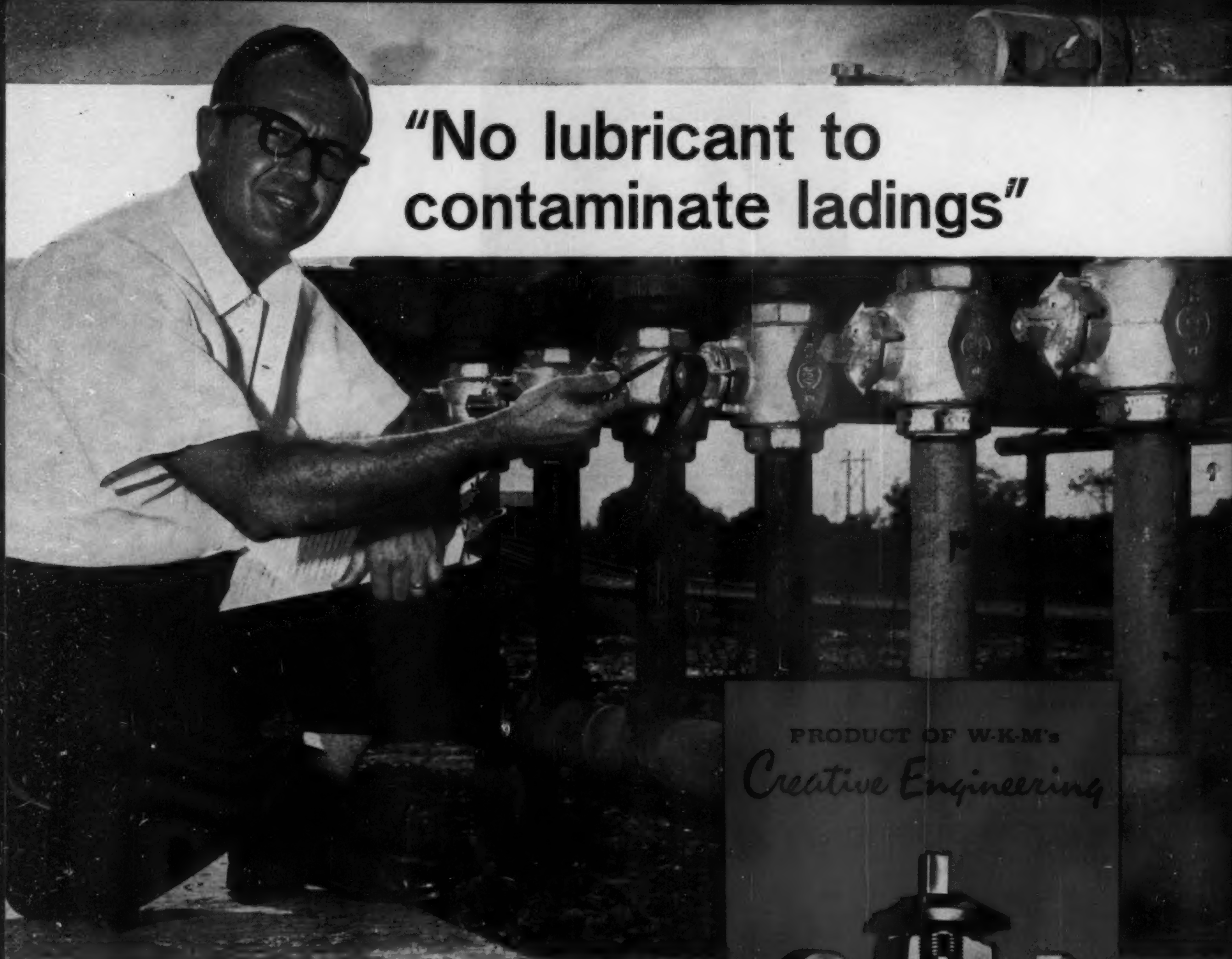
MECHANICAL ENGINEERING

March 1960

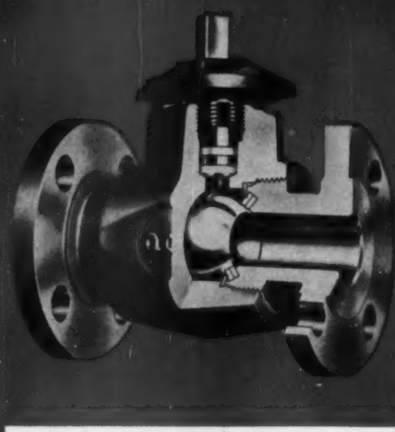
Cryogenic Gyro


a large
package boiler
that will give you
maximum efficiency and economy
You get most efficient steam generation when you select a boiler that's designed for your specific duty range. The B&W Type FO Package Boiler is your best buy if your requirements are in the range of 50,000 to 100,000 lb/hr. Not an enlargement of an existing product but a completely new oil and gas-fired boiler, the Type FO is engineered to give maximum efficiency, economy and quality.
... Check these B&W Type FO Package Boiler Benefits
Optimum Output because heating surface and furnace volume are properly balanced. And because B&W builds both the boiler and burner, they go together as a completely integrated steam generating package.
Minimum Maintenance is "designed in." For example, you get natural circulation, completely water-cooled furnace, skin casing, drainable superheater design.
Greater Efficiency Over Entire Operation Life optimum heat absorption — top burner performance — forced draft operation — constant steam temperatures over a wide load range.
Start Up Assistance B&W's extensive service organization assists you in starting up your boiler and gives instruction in its proper operation.
Whatever your particular steam requirements, check with B&W engineers when making your decision. You'll find a range of package boilers with industry-leading features. Call your local B&W representative or write direct to The Babcock & Wilcox Company, Boiler Division, Barberton, Ohio.
G-912
B&W
THE BABCOCK & WILCOX COMPANY
BOILER DIVISION



"No lubricant to contaminate ladings"

PRODUCT OF W-K-M's
Creative Engineering



ACF® non-lubricated Ball Valves

ACF Ball Valves are specially designed for ladings that require absolute purity. There is no lubricant, no possibility of contamination. The chrome-plated ball is suspended between Teflon seats under compression for leakproof sealing.

A quick quarter-turn operates this rugged valve. Specify it. You'll get efficient, economical performance. *Available at leading supply stores everywhere.*

Service-proved for 5½ years with such ladings as: gasoline • alkalis • liquefied petroleum gases • acetone • synthetic fuels • paint solvents • toluol • alcohol.

ACF non-lubricated Ball Valves feature full bore conduits, Teflon stem gaskets and seats that are sealed from the lading flow.

Working Pressures: In carbon steel with ASA ratings of 150 and 300, and a few sizes in ASA 600; in semi-steel with 200 and 400 pound ratings.

Sizes: ½" through 6".

WRITE FOR CATALOG 1000

W-K-M

DIVISION OF ACF INDUSTRIES
INCORPORATED
P. O. BOX 2117, HOUSTON, TEXAS

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MECHANICAL ENGINEERING

PUBLISHED BY
THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

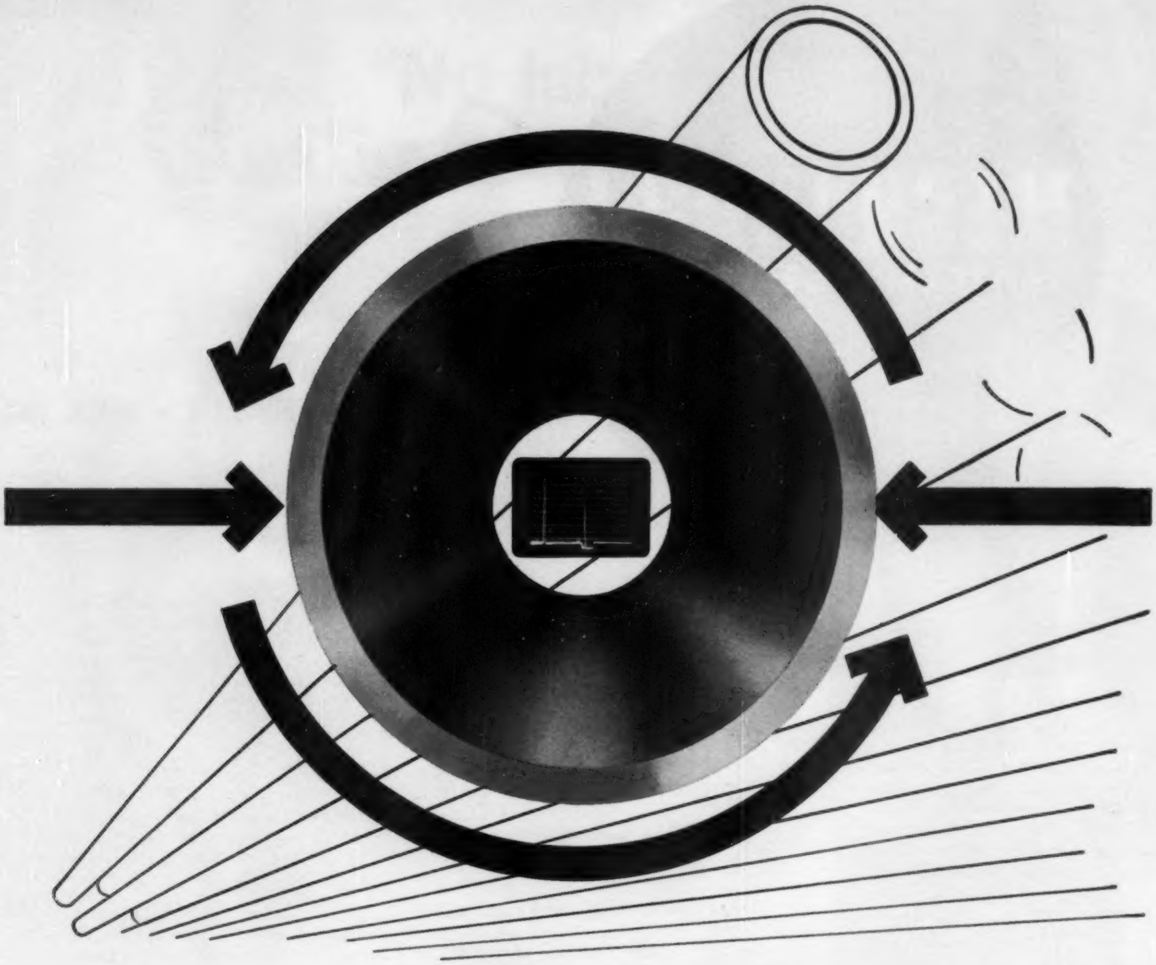
Contents

VOLUME 82 • NUMBER 3 • MARCH, 1960

THE COVER

"Project Spin." The device: A gryo which will rotate practically without friction, suspended by magnetism in a vacuum. The basic phenomenon: "Superconductance" of certain materials at temperatures approaching absolute zero. The men in this General Electric laboratory: James F. Young, Mem. ASME, **left**, and Karl F. Schock, Assoc. Mem. ASME. Mr. Young, newly appointed to the management of GE's Electric Utility Systems Operation, was Laboratory General Manager during the development of Project Spin. See p. 78.

Contents continued on following page



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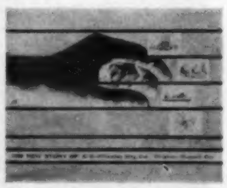


among the many components offered are: Condensers, Ejectors, Heat Exchangers — Bare Tube, Extended Surface Heat Exchangers,

IS VITAL PART IN

This part is shown 1½ times size. Actual weight: 2¼ lbs.

X-271-2

GRAPHITE COMPANY

DIVISION OF THE WICKES CORPORATION, SAGINAW 4, MICHIGAN


NEW!

KENNEDIZED DISCS INCREASE VALVE SERVICE LIFE BEYOND COMPARISON

KENALLOY STEM

Exclusive KENNEDY alloy that practically eliminates dezincification and corrosion and provides smooth, non-galling threads and bearing surfaces. This stem easily withstood constant mechanical 18 foot-pounds closing torque and after 25,000 cycles was like new.

PACKING

New type packing made of molded graphite asbestos with a Buna "N" binder required no replacement during or after 25,000 cycles.

NO GALLING

KENALLOY stem showed no galling at this important bearing point.

STEM THREADS

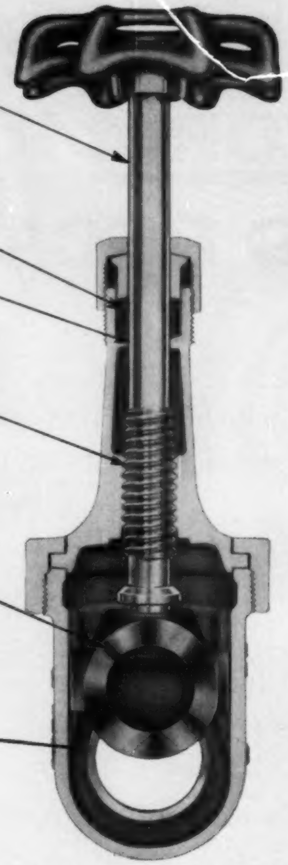
Only very slight wear and no galling were found on KENALLOY stem threads after complete tests.

KENNEDIZED DISC

The super mirror finish of KENNEDIZED disc actually improved with wear. Disc showed no galling or other wear marks after 25,000 cycles at 150 lbs. saturated steam pressure. This remarkable wear resistance is combined with an extremely low coefficient of friction, smooth sliding properties, excellent anti-seizure characteristics and corrosion and galling resistance. Tests proved these discs set a new and unmatched high standard in valve performance.

SEAT

The action of the KENNEDIZED disc was to place a high glaze finish on the seat. The low coefficient of friction and smooth sliding properties of the disc actually improved the finish on the seat. Here, again, no galling was found on the seat after 25,000 cycles.



Simply stated, KENNEDIZED is a special process that appreciably improves performance and increases life of metal wear parts. This is accomplished by increasing surface hardness, lowering the coefficient of friction and augmenting the resistance of base metal to corrosion and galling.

The process involves the deposit of a high chromium alloy which reproduces the original surface finish and contour of the base material, with no distortion of the parts processed.

This exclusive process, incorporated on KENNEDIZED discs, provides these highly desirable bearing properties:

1. Remarkable wear resistance.
2. Smooth sliding properties.
3. Extremely low coefficient of friction.
4. Unsurpassed anti-seizure characteristics.
5. Corrosion and galling resistance.

These characteristics were verified by a unique punishment test involving mechanical opening and hard closing of valves in operating service throughout 25,000 cycles. Details of test and complete valve structure are contained in Bulletin 574.

Fig. 525 KD
125-Pound S.W.P. Bronze Gate Valve

KENNEDY DISCS *NOW AVAILABLE* IN THESE KENNEDY VALVES

125-Pound S.W.P. BRONZE GATE VALVE

Non-Rising Stem, Inside Screw. KENNEDIZED Wedge Disc. Working Pressures: Saturated Steam, 125 lbs. W.O.G., Non-Shock, 200 lbs.

Fig. 427 KD

125-Pound S.W.P. BRONZE GATE VALVE

Union Bonnet, Rising Stem Inside Screw, KENNEDIZED Wedge Disc. Working Pressures: Saturated Steam, 125 lbs. W.O.G., Non-Shock, 200 lbs.

Fig. 525KD

200-Pound S.W.P. 550°F. BRONZE GATE VALVE

Rising Stem, Union Bonnet ¼"-2", Bolted Bonnet 2½"-3", KENNEDIZED Wedge Disc. Working Pressures: Steam at 550° F. 200 lbs., W.O.G., Non-Shock, 400 lbs.

Fig. 78 KD

300-Pound S.W.P. 550°F. BRONZE GATE VALVE

Rising Stem, Union Bonnet ¼"-2", Bolted Bonnet 2½"-3", KENNEDIZED Wedge Disc. Working Pressures: Steam at 550° F. 300 lbs., W.O.G., Non-Shock, 600 lbs.

Fig. 518 KD

• ***For complete details on KENNEDIZED DISCS write for Bulletin 574 or see your Industrial Distributor***

KENNEDY VALVE MFG. CO.

ELMIRA, NEW YORK

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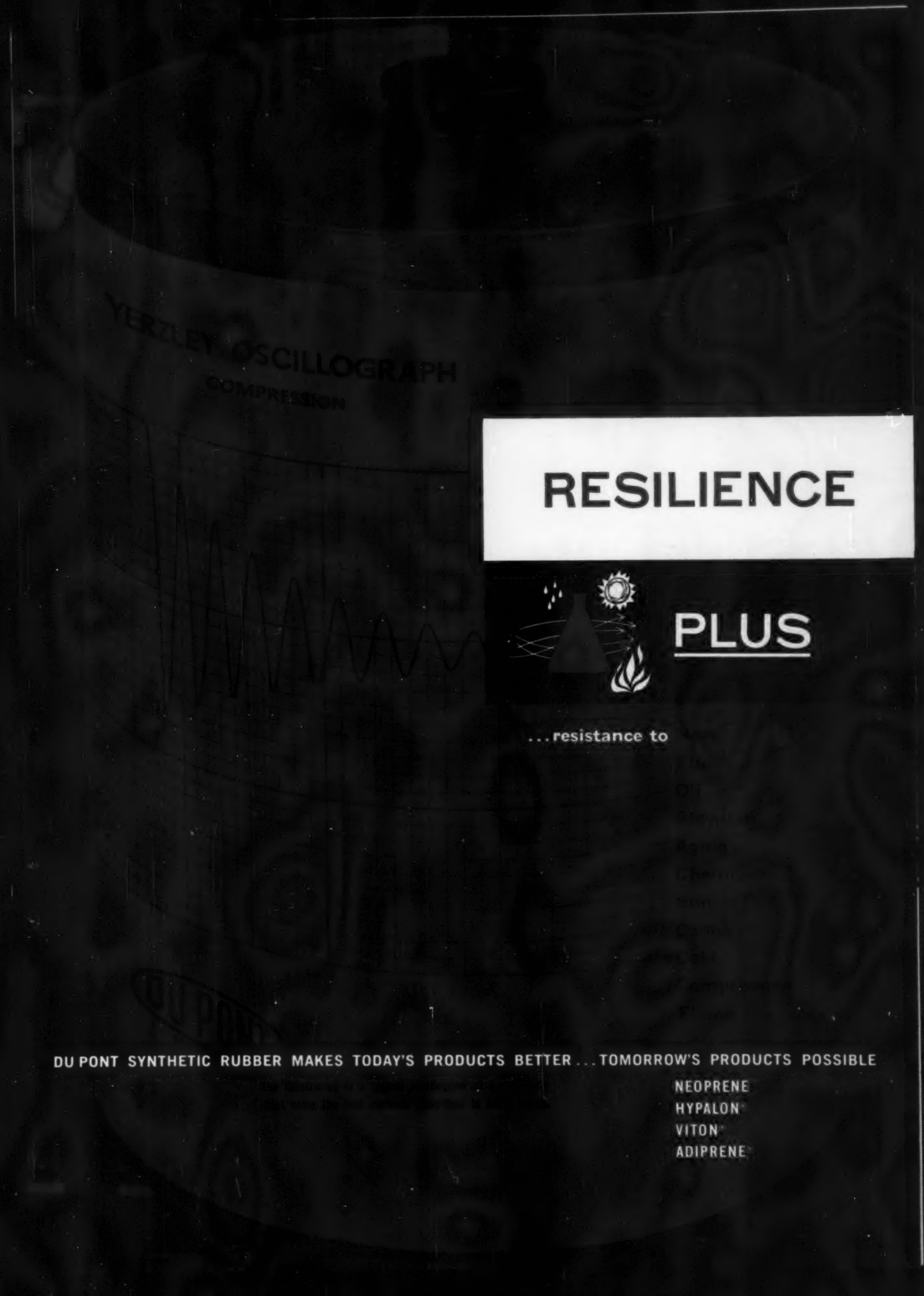
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COMPRESSION
RESILIENCE
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...resistance to
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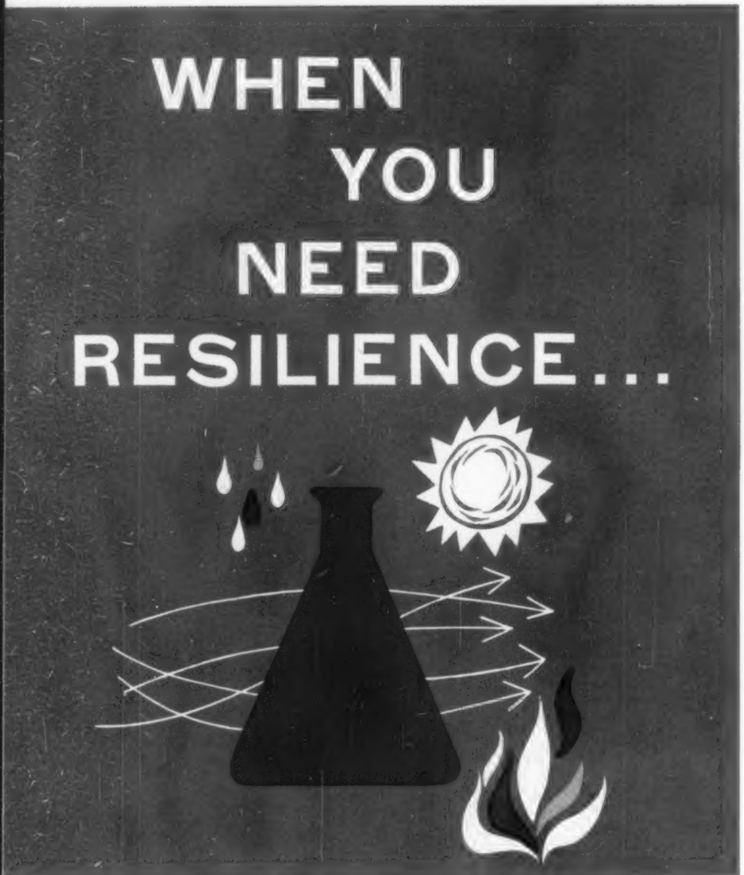
HYPALON
VITON
ADIPRENE



NEOPRENE

RESILIENCE PLUS A BALANCED COMBINATION OF PROPERTIES

Resistant to heat, flame, chemicals, sunlight, weathering, ozone, oils, grease and abrasion ... proved in performance by over 25 years of successful use in industry.

HYPALON®

RESILIENCE PLUS WEATHERABILITY AND COLORABILITY

Color stable ... ozone proof ... resistant to heat, oils, oxidizing chemicals, sunlight and weathering ... excellent for protective paints and fabric coatings.

VITON®

RESILIENCE PLUS RESISTANCE TO HEAT AND FLUIDS

Best of all elastomers in its resistance to corrosive chemicals, fluids and solvents ... performs at temperatures over 400° F.... excellent tensile strength ... low compression set, high modulus ... flame-resistant.

ADIPRENE® L

RESILIENCE PLUS HIGH LOAD-BEARING CAPACITY AND ABRASION RESISTANCE

A liquid polyurethane rubber excellent for casting, potting, molding ... forms a hard, resilient rubber with high load-bearing capacity, unusual abrasion resistance and outstanding low temperature properties.

Coiled heater cord for small appliances is jacketed with neoprene for long-term flexibility, resistance to heat, food chemicals and cooking oils. A test cord underwent 500,000 flexing cycles without damage.

Inflatable dam made from tube of neoprene-coated nylon is used in Los Angeles to divert river water for conservation. Test material withstood weather, sun, abrasion from river debris for two years.

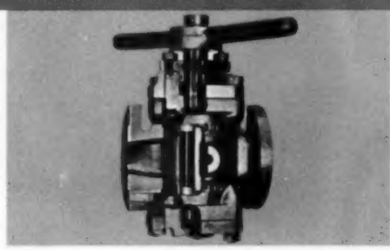
New air valve design for ventilation units is a helical spring covered with neoprene tubing. Neoprene tubing is expected to last as long as the ventilation system and still maintain a tight seal on the close-off.

House-size tarpaulin is used by fumigators to keep exterminating gases from escaping. It is made of nylon fabric coated with Du Pont Hypalon . . . resists sun, weather, fumigating gases . . . is easy to handle.

Cathedral roof with sprayed-on coating of Hypalon stays gleaming white in spite of tropical sun, wind, rain and salt spray. Weathering has not caused the reflective roof coating to dull or deteriorate since 1957.

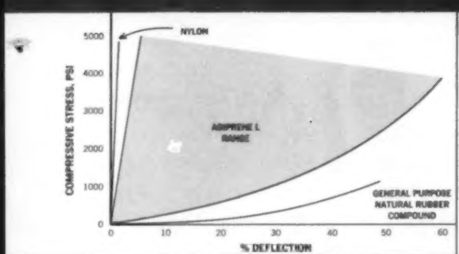
Hypalon shows outstanding resistance to strong oxidizing chemicals. This tubing was used to pump chlorine bleach (5¼% hypochlorite) at 158° F. . . . was still good after a week. Other rubbers failed in 24 hours.

Viton O-rings seal bearings in heat exchanger at 525° F. . . . outlast other synthetic rubbers 25 to 1. They resist fatty acids, dibasic acid, phthalic acid, solvent and petroleum products . . . maintain their resilience.

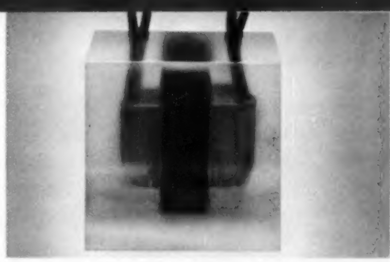


This refinery valve has been used in a benzene line for over a year. Its O-rings and valve seat —made from Viton—are still assuring positive shut-off. Viton parts also resist toluene, xylene, 380° F. alkylate gas, 400° F. propane.

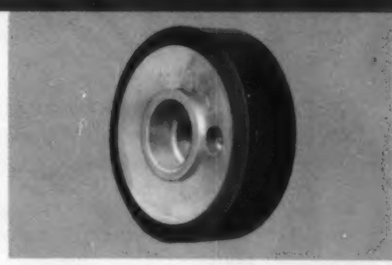
Fire seals in the wings of the new B-58 "Hustler" are made from Viton-coated asbestos fabric . . . resist heat, ozone, jet fuels, fumes and corona . . . are equivalent to stainless steel in fireproofing qualities.



Load-bearing capacity of hard Adiprene L compounds ranges between that of general purpose rubber and the harder plastics. You might use Adiprene L compounds to replace non-elastomeric materials where cushioning or damping properties are needed.



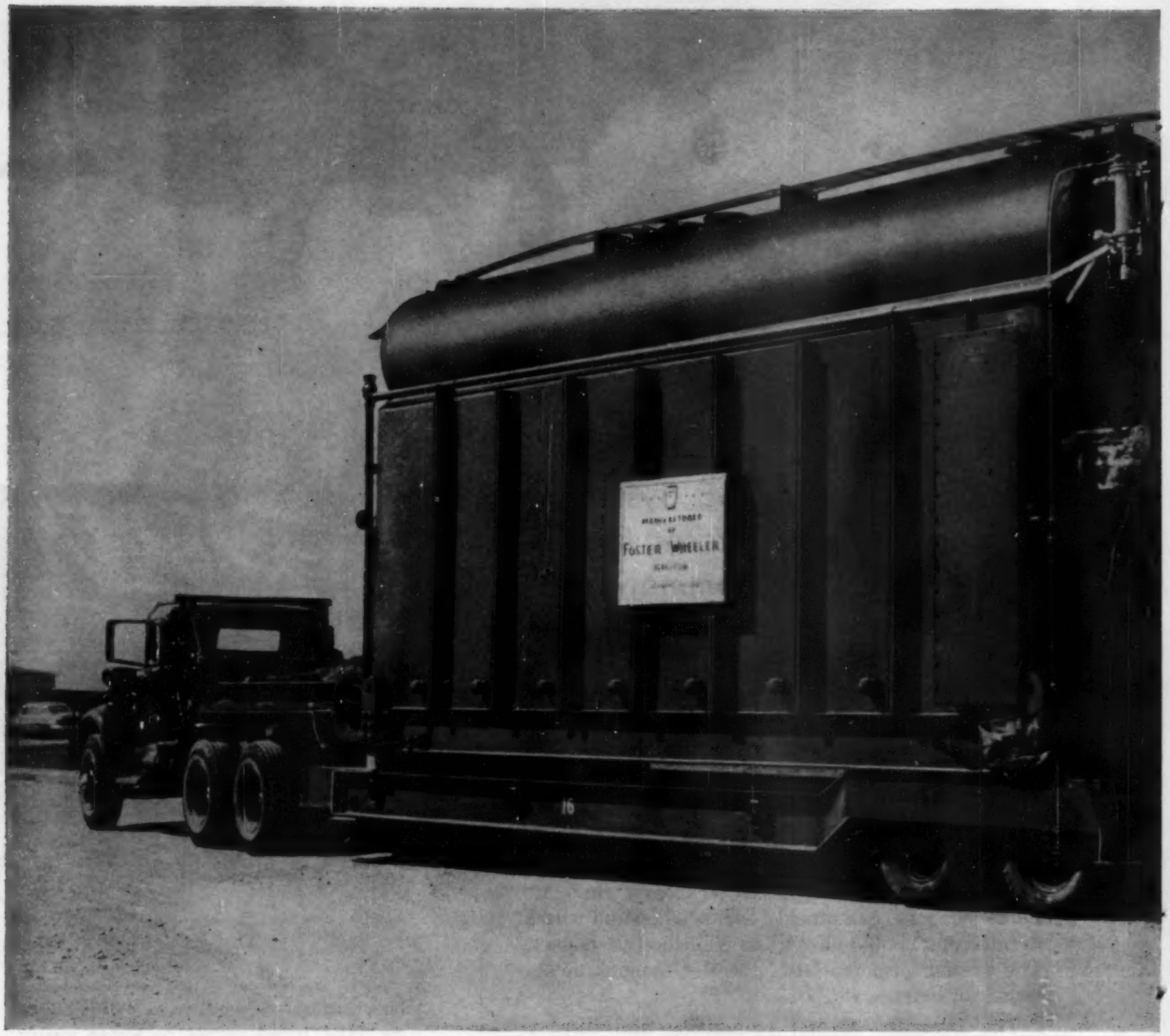
Adiprene L can be used alone or in combination with epoxy resins for potting and encapsulating electrical assemblies. Its flexibility helps protect delicate instruments from damage. It has excellent resistance to thermal shock.



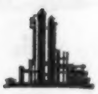
Industrial wheels made of Adiprene L outlast rubber and plastic . . . are outstanding in abrasion resistance. They resist oils, mild acids and alkalies, temperature extremes, weathering and aging . . . are resilient and non-marring.

DU PONT SYNTHETIC RUBBER MAKES TODAY'S PRODUCTS BETTER . . .

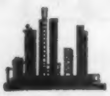
TOMORROW'S PRODUCTS POSSIBLE



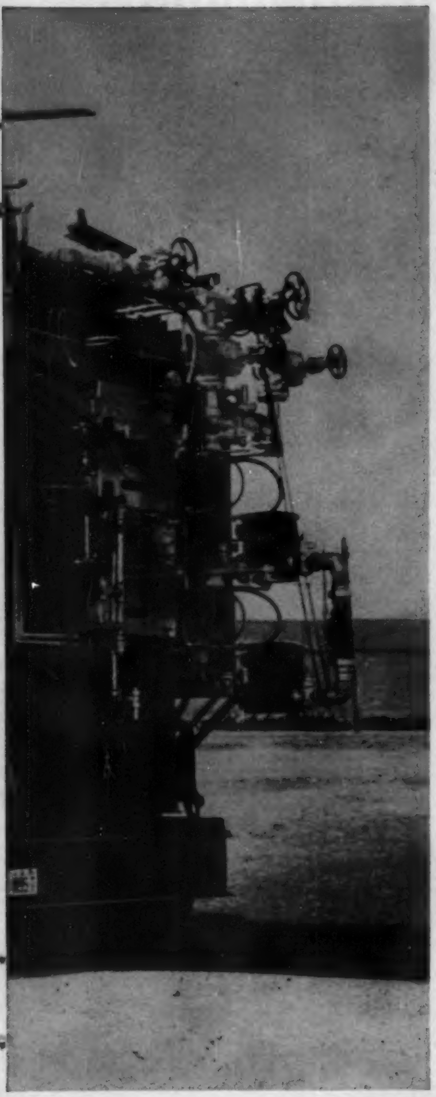
Foster Wheeler Packaged Steam Generator on its way to a refinery, where it is now producing 50,000 lb/hr of high-purity steam for processing and heating purposes.



—PETROLEUM PROCESSING



—CHEMICAL PROCESSING



Foster Wheeler delivers the steam you need and the economy and efficiency you want, in one package

If you need 13,000 lb/hr or more of steam at pressures of 250 psi or above, one of the best ways to begin planning your steam generator installation is by contacting Foster Wheeler right now.

This is Foster Wheeler's record of experience in meeting steam requirements with packaged steam generators.

The first water tube shop-assembled packaged unit was built by Foster Wheeler in 1940, to solve an important defense problem. Today, standard Foster Wheeler Packaged Steam Generators, firing fuel oil and gas separately or in combination, are serving refineries, process and manufacturing plants, hotels, dairies . . . virtually every type of business and industry throughout the world.

Most recent Foster Wheeler development in packaged steam generators is a stoker fired model, the first available to industrial users of steam.

In short, the *heat engineering* experience that goes into Foster Wheeler Packaged Steam Generators is unique in the power industry. And the result is a product engineered for dependable, economical and efficient production of high-purity steam . . . and delivered as a package which keeps installation costs to a minimum.

Make planning your steam generator installation easier by getting full information on Foster Wheeler Packaged Steam Generators *before* you start writing your specifications. Write Foster Wheeler Corporation, 666 Fifth Ave., New York 17, for Bulletin PG-58-2. Or better still, contact Foster Wheeler directly and discuss your steam requirements personally with one of Foster Wheeler's *heat engineering* specialists.

Heat Engineered products, plants and processes . . . for the world's power, petroleum and process industries.

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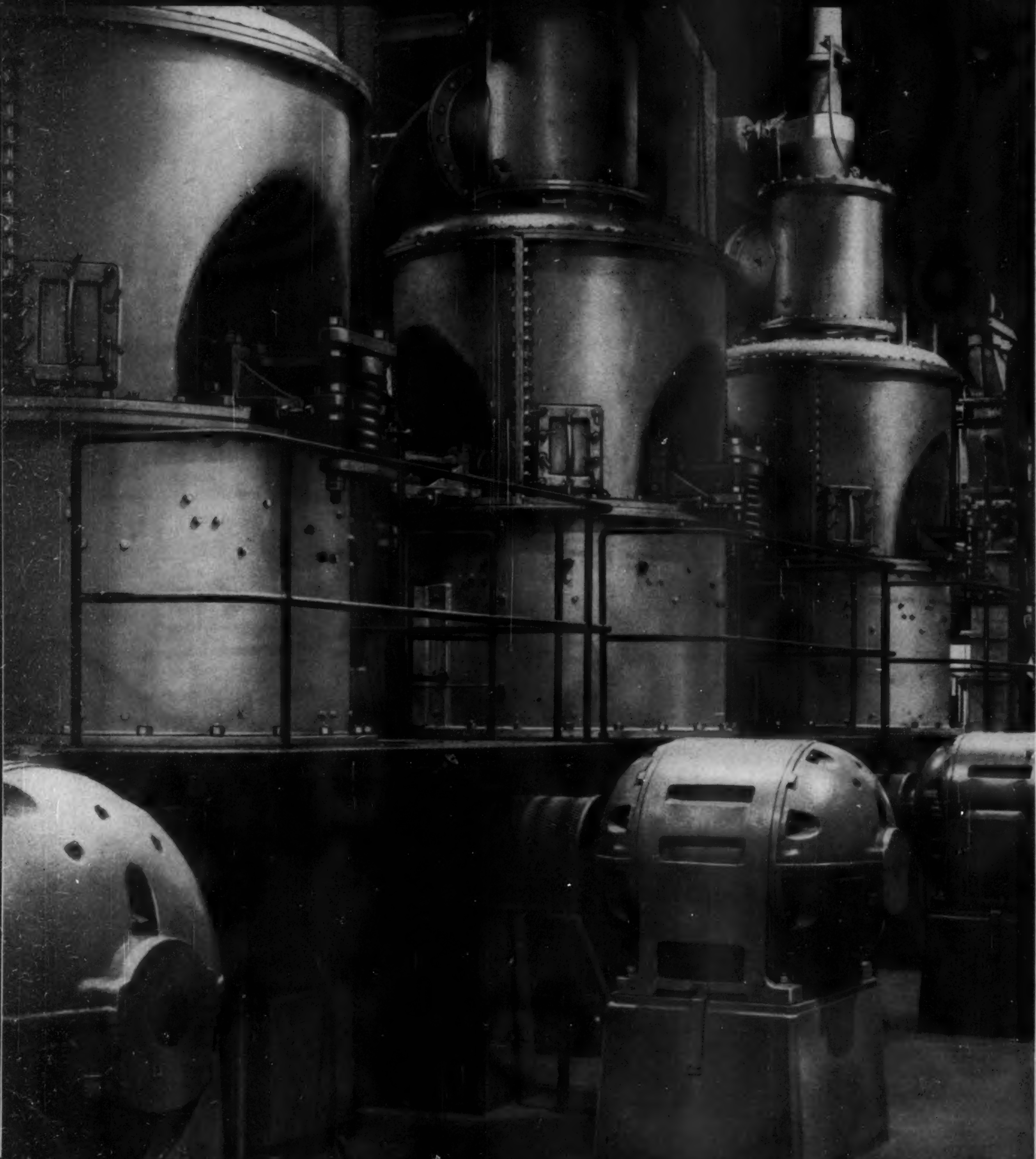
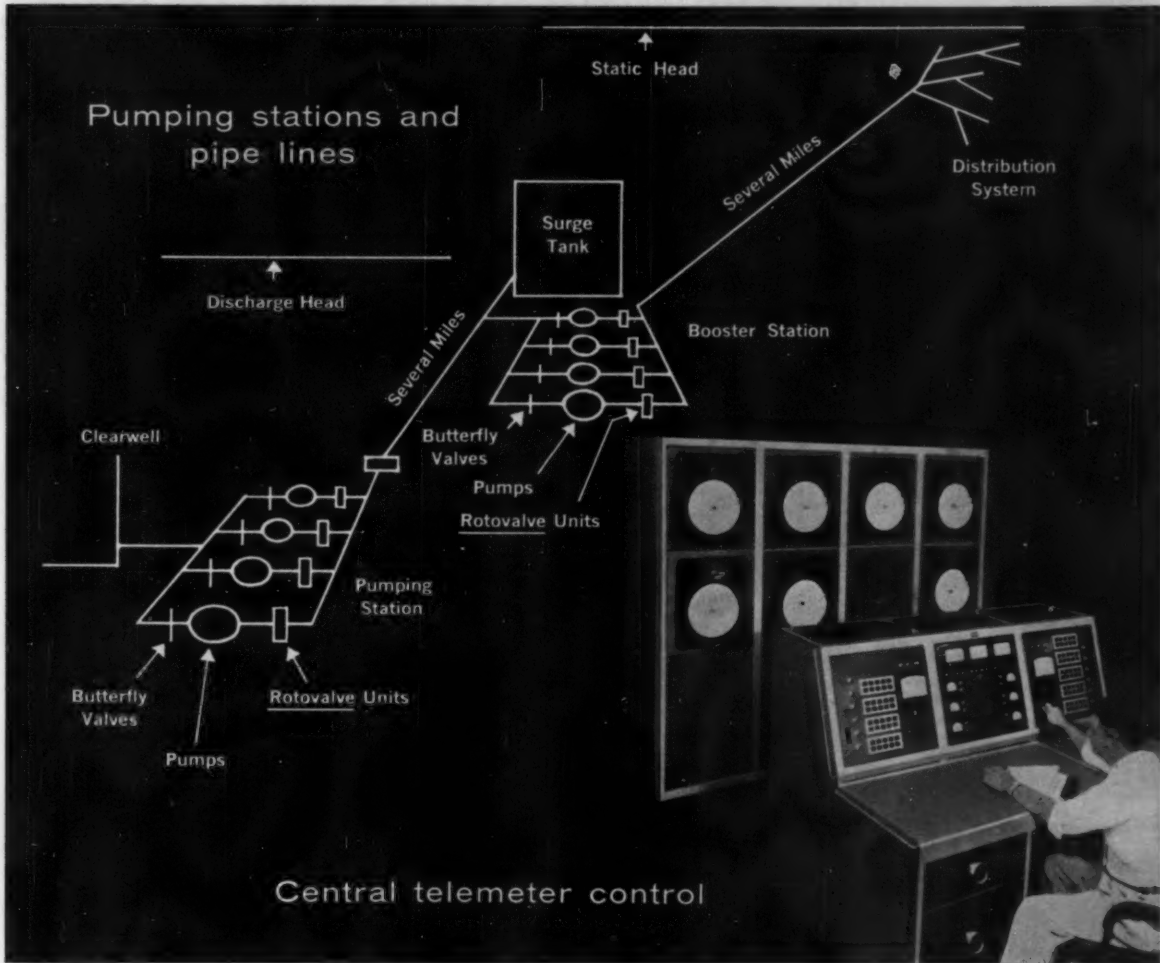
prepare the daily BTU diets of boilers



ALLIS-CHALMERS

A-1229



One man controls 60 mgd with

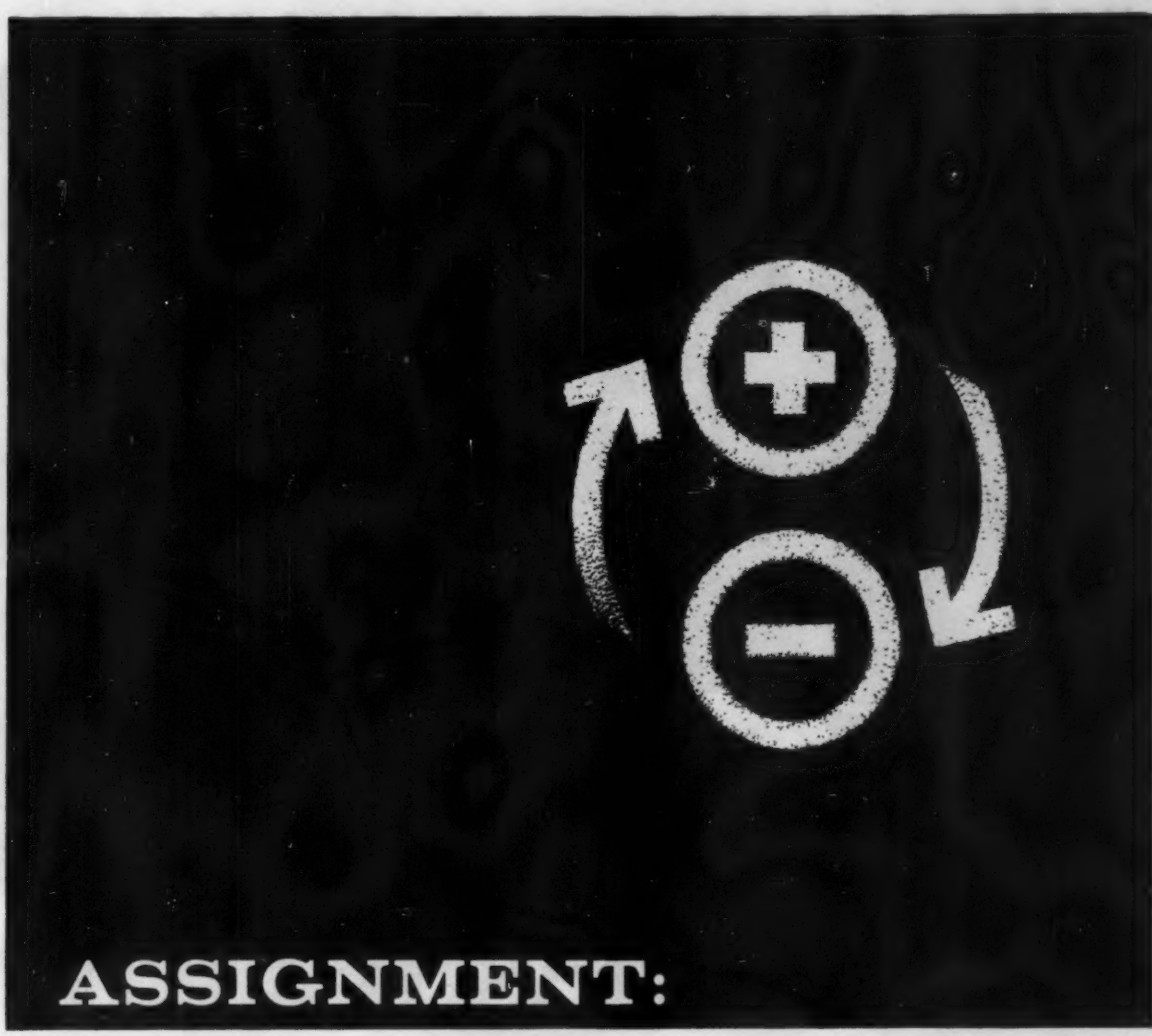
telemetered valving

Pumping stations operate completely unattended, controlled from a central remote console in this major water procurement and distribution system. Rated for 60-mgd peak load, it distributes over a 100-square-mile area from widely separated stations and storage tanks.

This is another dramatic example of complete valving service offered industry by Allis-Chalmers. Whatever you're dealing with, liquids or gases, including highest temperatures and pressures — Allis-Chalmers is your convenient source of today's most comprehensive rotary valve line. Types and sizes cover virtually every need . . . including *Rotovalve* units, butterfly and wafer valves and ball valves. We can also assist you in every phase of planning, engineering and installation. *Contact your Allis-Chalmers representative, or write* **Allis-Chalmers,** *Hydraulic Division, York, Pa.*

Key to a superior valving system, Rotovalve units offer the least pressure loss . . . ideal flow characteristic . . . controlled timing . . . positive seating . . . easy operation always.

Rotovalve is an Allis-Chalmers trademark.



CORROSION

How Lukens *Application Research* can help you find the right steel plate for the job

Migrating ions—superimposed on a photomicrograph of corroded steel plate—symbolize one of metallurgy's oldest assignments: the battle against corrosion. Developing new tactics in this constant campaign is the job of our Application Engineering staff.

For example, called on early in the planning stages, Lukens engineers recently attacked almost identical problems for two large processing companies—and came up with two completely different solutions.

The first involved a sugar refiner's vacuum pans. Frequent and costly cleaning was required to head off corrosion and product contamination. Our staff's prior research and experience in the food equipment field led it to suggest *nickel*-clad steel for the pans. (13% and 8% nickel-clad on A-285 backing steel.)

Cleaning and maintenance were equally costly to a leading chemical and dye company—in the protection of its nitrogen solution barge tanks. Here, our engineers found *stainless*-clad steel the most desirable answer. (12% 304L on A-212 backing steel.)

Armed with practical as well as technical knowledge of Lukens' wide range of special-duty steels, our Application Engineers have helped conquer corrosion on many fronts. That's why we say . . . *if your assignment is corrosion, let it be our assignment, too.* Contact Manager, Application Engineering, G-30 Services Building, Lukens Steel Company, Coatesville, Pa.

ASK FOR THE BULLETIN ON LUKENS CLAD STEELS

Helping Industry Choose Steels That Fit The Job

LUKENS

POWELL

WORLD'S LARGEST FAMILY OF

VALVES

performance makes the world of difference

POWELL HIGH PRESSURE VALVES

Gate, Non-Return, Globe, Angle "Y" and Check Patterns—all commercial sizes—for 150 to 2500 pounds and higher, for sub zero 1200 F. temperatures.

To handle the increasingly higher pressures and temperatures required by modern industry, Powell has the finest selection of quality steel valves with many exclusive Powell features of superior design and construction.

Many of these Powell Valves are stocked for quick delivery. Contact your city's Powell Valve distributor. Or write directly to us. Our engineers will quickly solve your industry's flow control problems in handling water, oil, gas, air, steam, corrosive fluids.

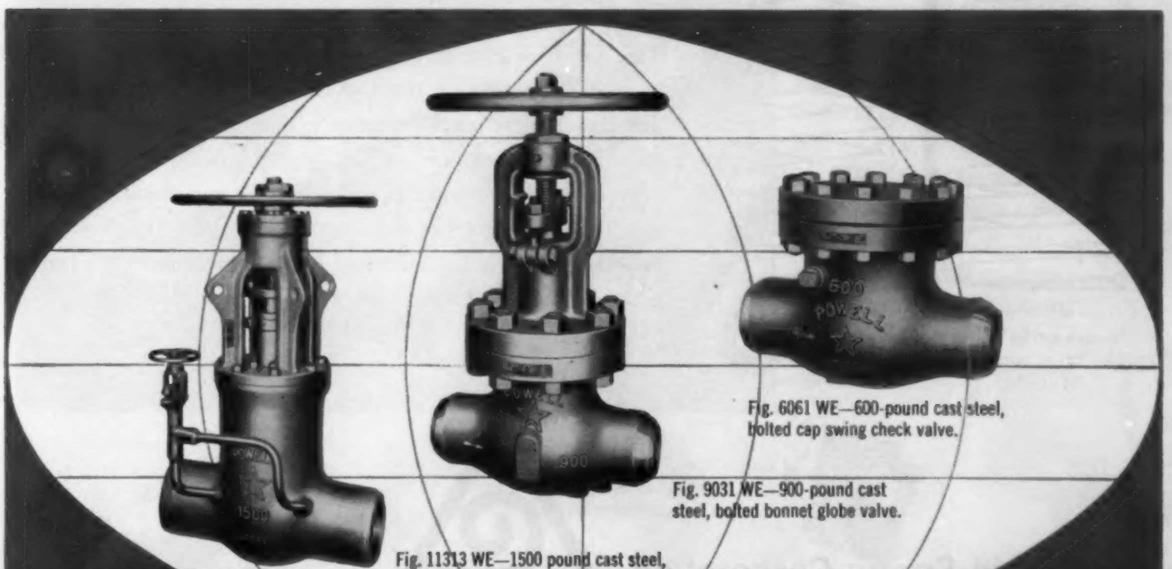


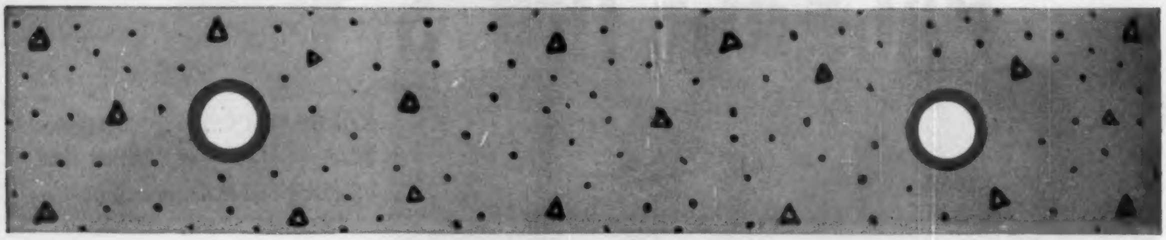
Fig. 6061 WE—600-pound cast steel, bolted cap swing check valve.

Fig. 9031 WE—900-pound cast steel, bolted bonnet globe valve.

Fig. 11313 WE—1500 pound cast steel, pressure seal gate valve with by-pass.

THE WM. POWELL COMPANY • DEPENDABLE VALVES SINCE 1846 • CINCINNATI 22, OHIO

4-D WROUGHT IRON PIPE



FOR SNOW MELTING AND RADIANT HEATING SYSTEMS

PROPOSAL FOR HIGH STRENGTH, CORROSION-RESISTANT INSTALLATIONS

New 4-D Wrought Iron has increased corrosion-resistance, improved mechanical and physical properties. It was achieved by substantially increasing the deoxidation of the base metal, slightly increasing the phosphorous content and using a more siliceous iron silicate.

Write for new 4-D Wrought Iron literature and specific technical information. A. M. Byers Company, Clark Building, Pittsburgh 22, Pennsylvania.

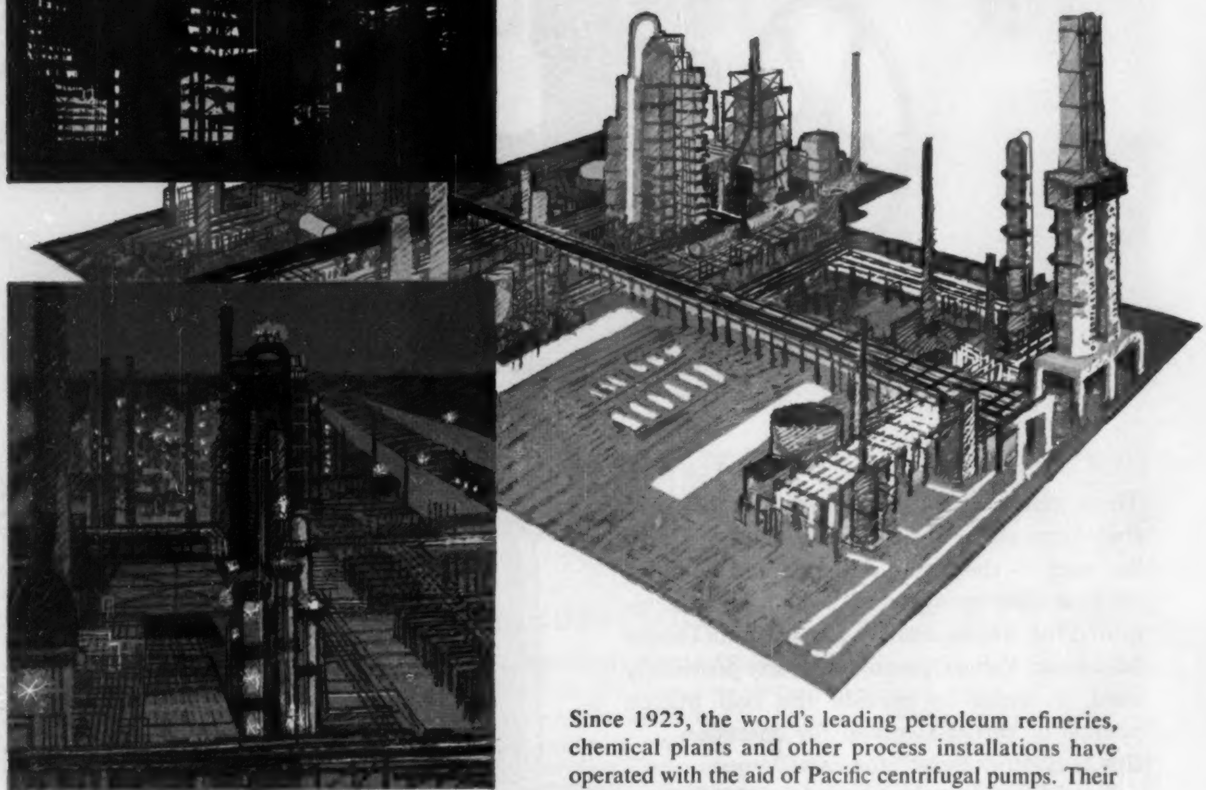
PIPE: THE MOST IMPORTANT SINGLE COMPONENT—Pipe for snow melting and radiant heating systems *must* resist corrosion. It is only accessible for repairs at considerable cost and inconvenience. Any leaks that might result are frequently difficult to locate with any accuracy. It is also virtually impossible to avoid some rough handling during the course of fabricating and installing such systems. So, strength is another piping must.

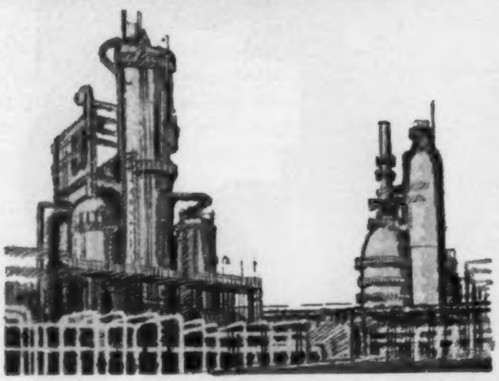
EXPANSION COEFFICIENTS AND WORKABILITY—Pipe is exposed to wide temperature ranges in these services. So there's always the possibility of unequal expansion damaging surrounding material. The coefficients of 4-D Wrought Iron and concrete are identical. This minimizes the possibility of concrete cracking due to thermal expansion. Additional advantages of 4-D are: good bending properties and the sound, durable welds that can be obtained as a result of its self-fluxing action.

SUITABILITY OF 4-D WROUGHT IRON—4-D Wrought Iron is corrosion-resistant, strong, compatible with structural materials over wide temperature ranges, and easy to fabricate. There is *no* "or equal." Historically, the *first* snow melting system in the U.S. was Wrought Iron: designed 34 years ago for Rochester Gas & Electric Corporation, Rochester, N. Y. No failures, ever. The *first* radiant heating system in the U.S. was likewise Wrought Iron: designed in 1938 for Frank Lloyd Wright's famed S. C. Johnson & Son Office Building in Racine, Wisconsin.

BYERS 4-D WROUGHT IRON

Who we serve proves *how* we serve





Since 1923, the world's leading petroleum refineries, chemical plants and other process installations have operated with the aid of Pacific centrifugal pumps. Their satisfaction with the cost-cutting efficiency provided by Pacific pumps is apparent in continuing repeat orders for plant expansion and new facilities.

There are several advantageous reasons for these re-orders; among them: (1) Pacific is a specialist in the development, design and manufacture of centrifugal pumps. (2) Pacific manufactures a wide variety of types and sizes to fill specific needs at the most beneficial cost/efficiency level. (3) Pacific provides technical advice and counsel to customers through an experienced sales engineering staff. (4) Pacific pumps may be financed in the leading currencies of the world.

There are other reasons why Pacific can serve you best. We would welcome an opportunity to tell you about them.

PACIFIC

Offices in all Principal Cities

PACIFIC PUMPS

Inc. . . A Division of Dresser Industries, Inc.

HUNTINGTON PARK, CALIFORNIA

IN-3

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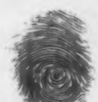

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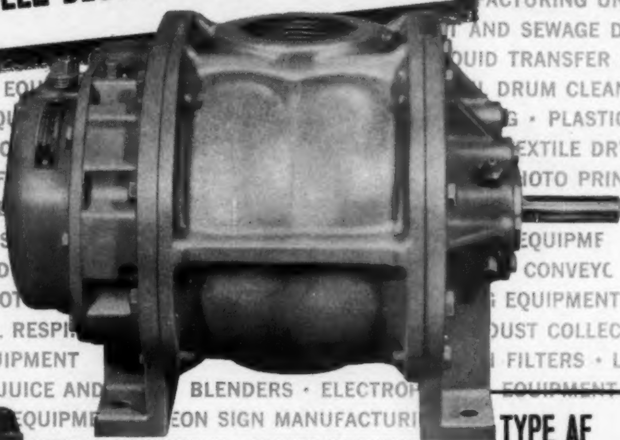

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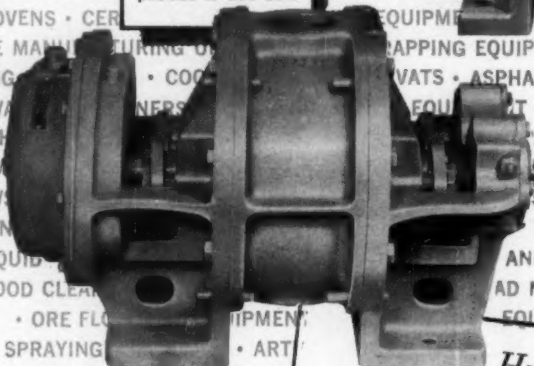

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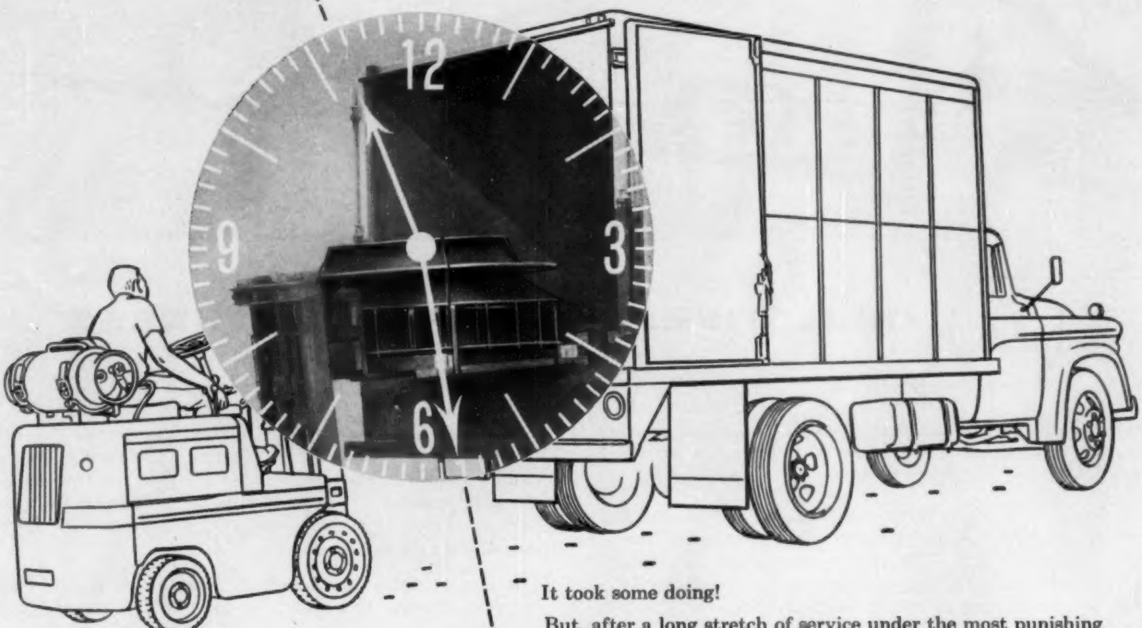

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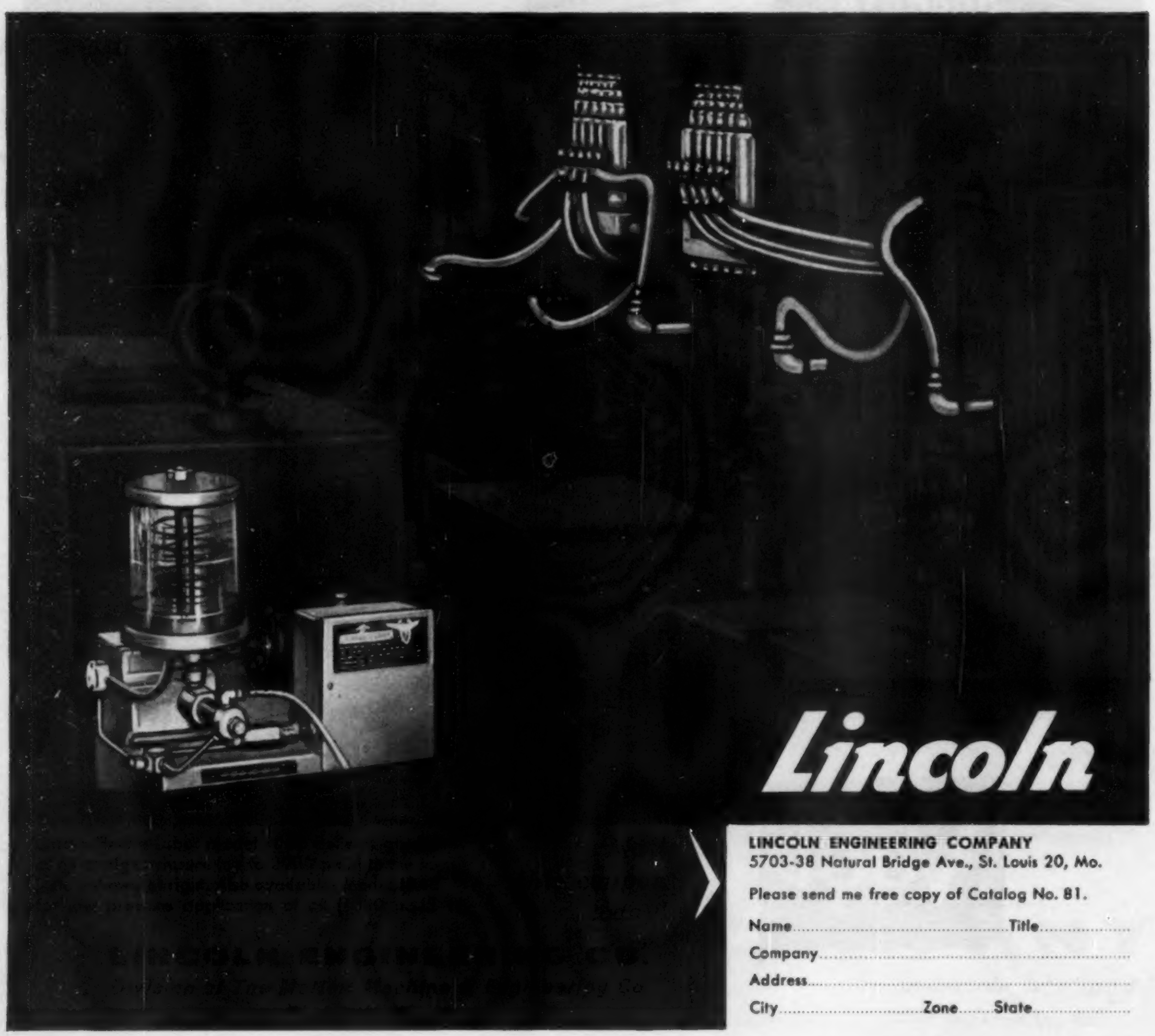

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MECHANICAL ENGINEERING

VOLUME 82 • NUMBER 3 • MARCH, 1960

Teaching Tomorrow's Engineers

"Nearly 10,000 new engineering teachers will be needed in the profession by 1967—more than the total number on engineering faculties in 1956. Will you be one of them?"

This alarming statement is the concluding paragraph in a pamphlet being distributed to seniors in engineering colleges throughout the country in an attempt to interest them in graduate school and then teaching as a career.

The pamphlet is issued by the Committee on the Development of Engineering Faculties of the American Society for Engineering Education, Urbana, Ill.

Actually about 1000 new engineering teachers per year are currently needed. Most of these teachers should be PhD graduates of our engineering schools, but only about 600 such degrees are being granted each year.

One problem then is to increase the number of competent students going on for advanced degrees. A greater problem, of course, is to channel the advanced-degree-bearing graduates into teaching.

The CDEF pamphlet is quick to point out, however, that choosing graduate study rather than seeking immediate engineering employment is not an irrevocable parting of the ways. While graduate work is essential to a teaching career, it is equally valuable as preparation for technical work in industry, especially in new and growing fields. Thus, whatever his choice, the student has everything to gain by going on to graduate school.

For the student with an empty wallet, the pamphlet also deals briefly with available fellowships and how to obtain them.

But what about the life of the engineering teacher? First, the ASEE Committee notes, the teacher continues to be a student. As he develops and matures, his study reaches far beyond the undergraduate's primary goal of "catching up" with present knowledge through elementary textbooks. The teacher's effort turns to more advanced work, to the current literature, and to new developments in his fields. Second, the engineering teacher's career offers the opportunity for combining teaching with creative professional work in research and consulting. Third, the teacher lives in an atmosphere created by bright, youthful minds, some indeed clearly keener than his own. Young people of the sort we find in engineering schools have large reserves of energy awaiting the challenge of the perceptive teacher. Fourth, the teacher, with his family, lives and works in a community where intellectual values are not only admissible but cherished, where individualism is not merely tolerated but honored. Fifth, the teacher's life is characterized by a large degree of self-direction—within only broadly defined responsibilities. Much of the teacher's personal work—apart from scheduled classes and conferences—can be done where and when he pleases.

Teaching, the CDEF cautions, like all jobs, has its routine tasks: The machinery of running a class or laboratory, counseling and registering students, grading their work, handling certain administrative duties.

And what about salaries? The pamphlet emphasizes that teachers' salaries—and even their total earnings—are likely to be somewhat less than could be earned in full-time engineering practice or in business, although latest figures gathered by Engineers Joint Council show that earnings of top engineering educators are comparable with the salaries of their peers in industry.

The choice between industry and teaching is, of course, a difficult one—but there are many satisfactions to be derived from taking part in teaching tomorrow's engineers.—*J. J. Jaklitsch, Jr.*

Editor, J. J. JAKLITSCH, JR.

THE TOWNE LECTURE

The Towne Lecture is in honor of Henry Robinson Towne, President of the ASME in 1889, whose paper in 1886 on "The Engineer as an Economist" initiated the flow of valuable Society contributions on scientific management.

The Challenge

By **James M. Gavin,** Executive Vice-President, Arthur

The meaning of the Space Age, and the quali-

SEVENTY-THREE years ago Henry Robinson Towne, President of ASME in 1889, initiated what are now known as The Towne Lectures. His subject was "The Engineer as an Economist." He was speaking at a time when the impact of the industrial age was well upon us and its meaning was meeting with our first clear understanding. An awareness was then growing of the need for the engineer to have a grasp of matters beyond his immediate concern, specifically economic affairs.

Now we are entering a new era, the Space Age, and today we must think of the engineer as a Space-Age man."

Basic Assumptions

There are a number of assumptions that we may make that will be reasonably applicable to our society in the mid-1960's.

First, a high degree of automation will characterize industrial practice as well as domestic living. Automation will invade the middle management areas of many industries. It will make possible a maximum use of limited capital investment through accurate control of inventories and rapid accounting and distribution systems.

Related to this aspect of automation will be a widespread use of aircraft for the movement of many commodities now moved by surface transportation. The present high-speed jet aircraft will then be replaced by aircraft flying in excess of 2000 mph, in excess of Mach 3, at first unmanned, with high-priority cargo and flying as programmed drones, and later for the movement of human passengers. This will contribute to a further shrinking of the economic, industrial, and military world bringing us closer together as a people.

It follows, therefore, that in this era the engineer must be a man who looks upon the world as one entity and understands it well. An "adjoining community" to him must mean more to him than it could have meant to Henry Robinson Towne 73 years ago. It must mean another nation and another continent, for they will be as close to us then in terms of time and travel as nearby cities were 75 years ago. It follows that the engineer must be a well-informed man, a man reasonably well based in the humanities, broad-gaged in his outlook—a man whose interest in local affairs is exceeded by his interest in and understanding of national and international affairs.

There are additional assumptions that we should make, the first being that the intense competition in which we are now joined with the Soviets will continue. I believe that we will avoid general war. However, the intensification of pressures around the periphery will continue with frequent uses of discreet force to achieve limited political and economic objectives. Fundamentally, however, the Soviet Union will seek to avoid general war in the interest of supporting a dynamic and fast-growing economy that they are convinced will, in Mr. Khrushchev's words, bury us. Looking back from the mid-1960's, we will realize that Mr. Khrushchev meant exactly what he said in the late 1950's: "I declare war on you, forgive the expression, in the realm of trade."

The Mid-1960's

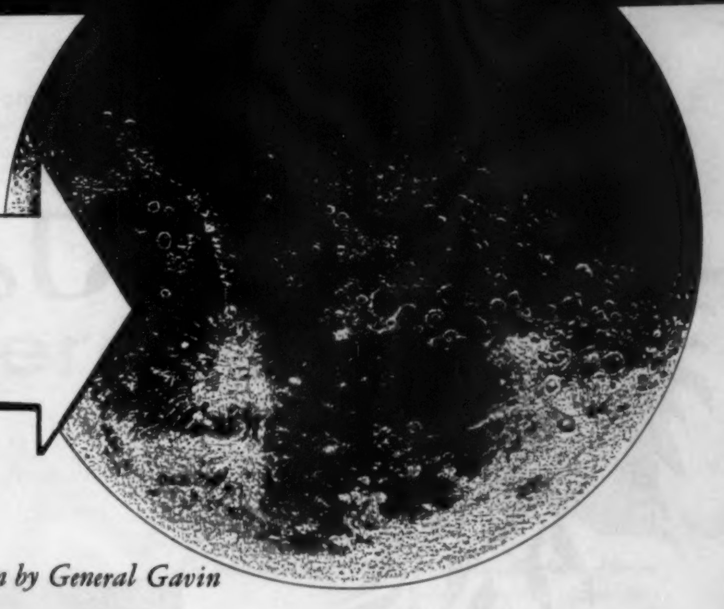
By the mid-1960's, Soviet influence will have spread economically and psychologically through Africa, Latin America, and many of the now uncommitted areas of the globe. The battle in the economic arena will then be fully joined, joined unto economic death. We will then, as a people, understand the nature of the competition and we will be working hard to overcome the almost irreparable damage caused by the apathy of the 1950's.

Either we will be doing this, or we will be numbering our days in misery for not having grasped sooner the significance of the Soviet challenge and the urgency of time.

Men on earth now seek to explore space, seeing among other things the fruits of their labors in better and less expensive world-wide communications systems, more reliable navigation systems, an understanding of and, to

Based on the Towne Lecture presented at the Management Luncheon during the Annual Meeting, Atlantic City, N. J., November 30–December 4, 1959, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

of the 1960's



D. Little, Incorporated, Cambridge, Mass.

fications of the Space-Age engineer, as seen by General Gavin

some degree, control of the weather—and finally for the first time in the history of man on the earth, the possibility of lasting peace through a United Nations surveillance system.

When our engineers, our scientists, our technicians, and our economists can develop the materials, methods, and systems requisite to the challenge of the Space Age, then will man be free of Earth's enslavement. Then will the people who achieve these things become a great nation of the Space Age, bringing for the first time lasting peace to mankind and a standard of living and a way of life far better than man has ever known.

The Role of the Engineer

The Space-Age engineer must have a distinct capacity for innovation. The problem may be one of handling tons of liquefied gases in a weightless condition in a space vehicle, or designing a dwelling suitable for human habitation near the polar regions of the moon, or a vehicle for travel on Mars, or simply a system for receiving, processing, and distributing hundreds of thousands of satellite communications in a short period of time. In endeavors such as these he will have to work closely with scientists of entirely different and diverse fields. And to do this he will have to understand what they do and, of course, communicate accurately with them.

A BS or an MS of 20 years ago, or even 10 years ago, is no assurance of an understanding of today's technology; one must continue the process of education. As a young Arthur D. Little engineer expressed it to me recently, "A Space-Age engineer with a nuclear-age education is out of step with the times." Nor is it sufficient to be able to refer to the Engineer's Handbook and the slide rule; one must know the fundamentals behind the formulas and the equations. And this brings up the problem of the education and training of engineers.

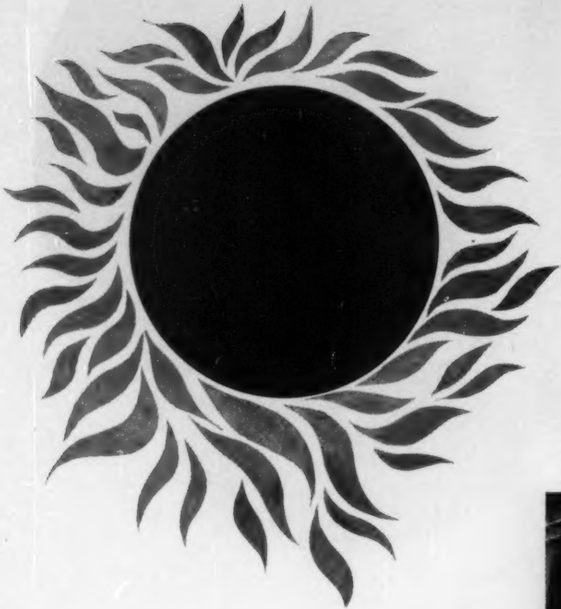
The evidence of the numbers of graduated Soviet engineers compared to our own should be a cause for deep concern. Certainly we must increase the numbers of students in engineering as well as intensify the educational process to which they are exposed. Otherwise we will, in time, be talking about the "engineer gap" with the same concern with which we now discuss the "missile gap."

The engineer's skills, working with the many new materials and processes of tomorrow's technology, will bring to our lives many things now undreamed of. It is this conversion of military-space technology to other uses, through materials, methods, and processes, that will provide the basis for a dynamic, growing technology that, in turn, will provide the economic base for an adequate space program. Already this process is well under way. In the past few years we have seen developments, from a drug for treating mental ills that was developed from hydrazine (a missile propellant), to heart valves, kitchenware, jet earth-drills, and exceptionally high-performance computers.

The Space Age: Its Meaning

By the mid-1960's we will more fully appreciate the meaning of the Space Age in terms of the relationshp between our own national economy and the achievements of our space programs. Looking back, we will realize that a preoccupation with missiles for solely military purposes was as shortsighted as the view, 1910 to 1920, that the airplane was exclusively a military vehicle, an ultimate weapon that would put an end to warfare forevermore. We will come to realize that while the landing of a man on the moon was a brilliant scientific-physical achievement, its greater significance was in the clear evidence that the economic, scientific, and engineering standards of the nation that accomplished it were far in advance of the backward nuclear-air-age nations with which it was in competition.

By then we will understand that space is the great strategic arena in which the future of mankind will be resolved. Either we will have the vision to see the meaning of the Space Age in terms of our own economy and our own survival, the courage to make the decisions that must be made, and the industry, both as individuals and as a people, to make that vision a reality, or we will not survive with a way of life as we now know it.



Japan Applies

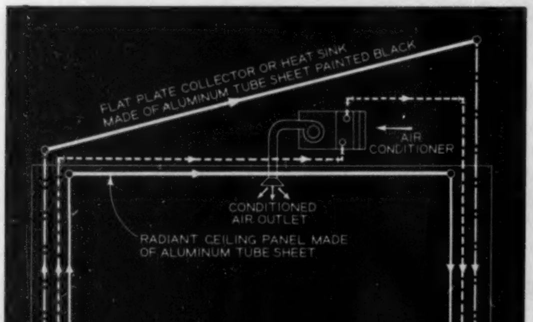
The land of the rising sun puts

Aerial view of the Yanagimachi solar-heated house in Tokyo. The roof serves as heat collector in winter and as a night-sky heat radiator in summer.

Aluminum tube-in-strip serves as heat-absorbing roof on the Yanagimachi residence. Radiant ceiling panels are made of the same material.

Heat-reflective paint aids in the distribution of the heat reflected by the ceiling panels.

Radiant heating and electric lighting are combined in fixtures suspended from the ceiling in the office.



Schematic of the system utilizing solar energy. Heat storage tanks and heat pumps serve for room heating or cooling and another heat pump furnishes hot water. Symbols used: Heat pumps—**HP_1** for heating and cooling, **HP_2** for hot-water; circulating pumps—**P_1** for collector or heat sink, **P_2** for air conditioner, **P_3** for radiant ceiling panel; valves—**v** for summer-winter changeover, **c** for temperature control. The lower-temperature heat-storage tank has a capacity of 10,800 gal ranging from 68 to 51 F in winter, 50 to 41 F in summer. The higher-temperature tank: 2700 gal capacity, in winter 104 to 95 F, and in summer 95 to 86 F. Hot water is stored at 113 F.

By John I. Yellott,[1] Mem. ASME,
Chairman, Solar Energy Application Committee

Solar Energy

the sun to work. An on-the-spot report from an expert.

THE vitally important problem of rebuilding cities and industrial facilities, and a continuously rising deficit in the meager supplies of coal, have made Japan the first nation to use the sun's radiation for supplying domestic energy needs in any substantial quantity.

The Committee on Applied Solar Energy of the Japan Society of Mechanical Engineers, of which Ichimatsu Tanishita, head of the Department of Mechanical Engineering at Keio University, is chairman, has given leadership to the development of solar equipment.

Most of the solar development work in Japan during the past 10 years has had immediate and practical objectives: (*a*) To find simple but effective ways for using the sun's radiation to heat homes and their hot-water supplies; (*b*) to develop higher-temperature collectors for cooking and steam generation, and solar furnaces for industrial research; (*c*) to develop direct converters for producing electricity from sunshine; (*d*) to find accelerated photosynthetic processes by which the output of food from a given area of land could be greatly increased.

All of the solar-energy research establishments in the Tokyo area were visited during October, 1959, and this progress report on the work which has been done under the auspices of the JSME Committee summarizes the information given so freely by Professor Tanishita and his colleagues.

Japan's Solar-Energy Resources

Measurements of solar-radiation intensity and sunshine duration have been made since 1948 by a network of some 30 stations located in all parts of Japan. The country, a rough and mountainous area, smaller than the state of California, lies between 32 and 45 deg N latitude and receives about 2000 hr of sunshine per yr. The average value for Tokyo is 1893 hr, while the great industrial area of Kobe-Osaka receives about 2170 hr. Since Japan is an island nation, her skies are covered with clouds to about the same extent as the New England, Great Lakes, and Northwestern areas of the U. S.

The yearly mean value of solar radiation received on a horizontal plane varies from a maximum of 1480 Btu per sq ft per day in the southwestern region to a minimum of 880 Btu in the fog enshrouded northeastern islands. The data for Tokyo are typical for central Japan:

Value of Solar Radiation Received on Horizontal Surfaces at Tokyo

	Spring	Summer	Autumn	Winter
Clear days only, *A*, Btu per sq ft per day	1590	1660	1150	1065
Average of all days, *B*, Btu per sq ft per day	1200	1210	820	702
Ratio, *A/B*	1.33	1.37	1.40	1.54

The distribution of solar radiation is mostly affected more by meteorological factors than by latitude.

Although the intensity and duration of sunshine in most of Japan are relatively low, the incentive for learning how to use solar energy is great. Coal and oil for use in residential fuel-burning equipment cost as much as $3.50 per million Btu, and the charcoal widely used for cooking is even more expensive. Hot water for bathing plays an important part in the life of a typical Japanese family, and the low winter temperatures make some form of house heating essential. Electricity is available almost everywhere at rates ranging from 1 to 2 cents per kwhr, but gas is available only in the cities.

Thermal Applications of Solar Energy

Solar Water Heaters. By far the most important application of solar energy in Japan is the heating of water for domestic uses. More than 200,000 solar water heaters are in use throughout central and southern Japan, ranging in design from simple flat pans with blackened bottoms to the most modern glazed collectors using aluminum "tube-in-strip." The first public exhibition of solar-energy equipment in Japan, held on a Tokyo roof-top in October, 1956, included a dozen different water heaters, and more have been devised since.

Simplicity in construction and operation is the keynote of Japanese-designed solar-utilization equipment. Control equipment is kept to an absolute minimum, since man power is usually available to perform such chores as opening and closing valves, and turning pumps on and off. Most solar heaters are designed to drain automatically when the water supply is shut off, to minimize the danger of freezing. A supply of water is solar-heated during the day, and available for evening hot baths. Since automatic dishwashers and laundry machines are not widely used, the demand for hot water during daylight hours is usually small.

The simplest solar water heaters, of which more than 20,000 are in use in Japan, are plastic envelopes or "pillows," with transparent tops and black bottoms. A water-inlet and outlet line is connected to the bottom of the heater, and an air vent is provided at the top.

[1] President, John Yellott Engineering Associates, Phoenix, Ariz.

Contributed by the Solar Energy Application Committee and presented at the Annual Meeting, Atlantic City, N. J., November 29–December 4, 1959, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

Japan Applies Solar Energy

The heater is simply exposed to the sun on a flat roof area and filled with water from the house supply on each clear day. By evening, about 30 gal have attained 110 to 120 F and are ready for the deep, cylindrical bathtubs which are a part of every Japanese house.

Metallic water heaters, using steel or aluminum collecting surface, are in wide use. The simplest employ steel tubes welded to heaters, with blackened steel sheets tack-welded to the tubes. Mounted in shallow boxes with insulation behind the sheets and single panes of glass above the tubes, these collectors can reach efficiencies of 80 per cent in summer and 60 per cent in winter.

With the introduction of aluminum "tube-in-strip" in Japan several years ago, a number of new designs of solar water heaters came on the market, differing from their American counterparts principally in the construction of the heaters. These are usually made by rolling the ends of the strip up into cylindrical form after the inner portion of the tube has been cut away. The seam and ends are welded by the heliarc process. Flanges welded to each end of the headers permit units to be bolted together to form a collector of any desired area. Aluminum is used instead of the copper which is more common in the United States, because of the great cost differential.

Solar House Heating. At least five solar heating systems have been designed and put into operation in and around Tokyo by Masanosuke Yanagimachi, a consulting engineer in the field of thermal engineering who has established his own Applied Solar Energy Research Laboratory. His first system, unfortunately destroyed by fire in 1957, used 540 sq ft of vertical south-facing collecting surface. A heat pump boosted the sun-heated water's temperature to the point where it could be used in a radiant-heating system. The same collector surface served in summer as night-sky radiator to dispose of the heat which the air-conditioning system had gained during the day.

The residence built by Yanagimachi in 1958 uses aluminum tube-in-strip to cover its entire roof area. The house-heating section of the roof covers 1078 sq ft in a series of panels, each 30 ft long and 2.5 ft wide. The domestic water-heating system covers 363 ft, using panels of the same width but shorter in length. The tube-in-strip serves as roof surface as well as heat collector. The larger area is also a summer night-sky heat radiator. The aluminum panels are ingeniously fastened to the roof and are completely watertight.

Heat storage is provided by two concrete tanks in the basement of the house. A 9500-gal tank stores water heated in the solar collector during the day. A 2375-gal tank stores water warmed by a 3-hp heat pump. Its evaporator or heat-absorbing coil is in the larger, cooler tank and its condenser is in the smaller warmer tank. Thus the sun-heated water supplies most of the energy despite the fact that the heat is collected at relatively low temperature. The heat pump up-grades the solar heat to the point where it can be used in the radiant ceiling panels. These are another unique feature of the Yanagimachi house.

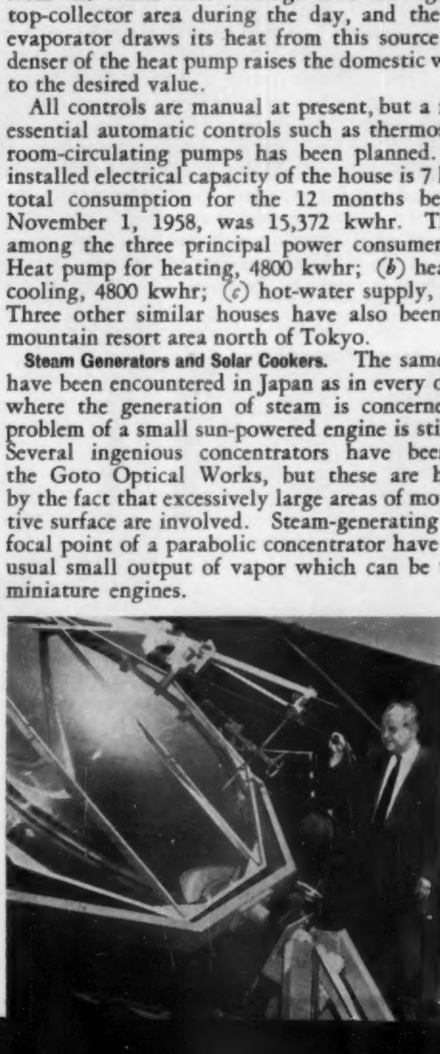
They are made of the same kind of aluminum tube-in-strip panels which are used on the roof and are the primary means of distributing heat to the rooms on the first and second floor. The walls of the principal rooms are covered with reflective papers, attractive in appearance and effective in reflecting the heat radiated by the ceilings. Reflective-fabric window curtains retain the heat within the rooms during the winter and exclude unwanted sunlight in summer. A small heat-exchanger-fan combination circulates 216 cfm of conditioned air throughout the house.

During the summer, the heat pump's valves are reversed and it chills the water in the smaller storage tank, rejecting the heat to the water in the larger tank. The chilled water is pumped through the radiant ceilings, while the warmed water from the large tank is pumped through the roof panels at night to dissipate its excess heat by radiation to the night sky.

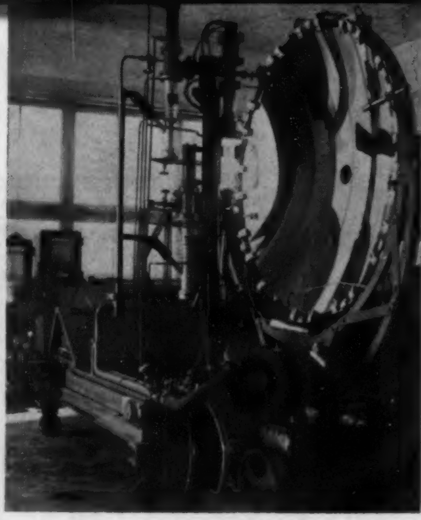
The domestic hot-water system uses a miniature heat pump to raise the temperature of the sun-heated water to the relatively high value which is characteristic of Japanese baths. A small ($^1/_8$-hp) pump circulates water from the warm-water storage tank through the roof-top-collector area during the day, and the heat-pump evaporator draws its heat from this source. The condenser of the heat pump raises the domestic water supply to the desired value.

All controls are manual at present, but a minimum of essential automatic controls such as thermostats on the room-circulating pumps has been planned. The total installed electrical capacity of the house is 7 kw, and the total consumption for the 12 months beginning on November 1, 1958, was 15,372 kwhr. The division among the three principal power consumers was: (*a*) Heat pump for heating, 4800 kwhr; (*b*) heat pump for cooling, 4800 kwhr; (*c*) hot-water supply, 5800 kwhr. Three other similar houses have also been built in a mountain resort area north of Tokyo.

Steam Generators and Solar Cookers. The same difficulties have been encountered in Japan as in every other nation where the generation of steam is concerned, and the problem of a small sun-powered engine is still unsolved. Several ingenious concentrators have been built by the Goto Optical Works, but these are handicapped by the fact that excessively large areas of movable reflective surface are involved. Steam-generating coils at the focal point of a parabolic concentrator have given their usual small output of vapor which can be used to run miniature engines.



Adjusting a sample at the focal point of the Goto solar furnace



Metallic oxides are being fused and crystals grown with the aid of solar furnaces at the Government Industrial Research Institute at Nagoya

Solar cookers of various types have been built by the Goto Optical Works. A mirror-lined-reflector rice cooker was demonstrated by Mr. Goto in the United States in 1955, and he exhibited other types at the 1956 Tokyo exhibition, including an umbrella-like reflector, lined with aluminized plastic film. Lack of a suitable high-temperature heat-storage process is a major obstacle in developing solar cookers for use in areas of intermittent sunshine.

Solar Furnaces. Solar furnaces are being put into particularly effective use at the Government Industrial Research Institute at Nagoya. Two furnaces of the converted searchlight type are in use; one, which follows the sun directly, is mounted on the roof of the Research Institute, while the other, which uses a heliostat to follow the sun, is enclosed in its own building, with a removable roof. This work is being carried out under the direction of Tetsuo Noguchi, with the assistance of Taro Isada and Hisao Mii. Dr. Noguchi spent 1959 in the United States, studying solar furnace operation at the University of Minnesota and at Arthur D. Little, Inc., Cambridge, Mass. Outstanding work is being done in the fusion of metallic oxides, and the solar furnace is being used for the first time in the growing of crystals. The apparatus which has been developed for this purpose is shown above.

Solar-Electric Apparatus

The silicon battery's possibilities were recognized in Japan as soon as it was announced by Bell Telephone Laboratories. The characteristics of silicon semiconductors of various kinds have been studied for several years at the Electrotechnical Laboratory, operated since 1948 by the Agency of Industrial Science and Technology of the Ministry of International Trade and Industry. The Laboratory's Power Application Section, directed by Tsuneo Momota, has just begun a long-term test of a large solar battery mounted on an unobstructed rooftop. Very significant work is also under way on ways and means for producing large-area solar cells.

Large-scale production of silicon solar cells has been undertaken by the Research Laboratory of the Nippon Electric Company, where development began in 1955. The first large solar battery to be put in service in Japan was installed in November, 1958, in an ultrahigh-frequency repeater station at the top of Mt. Shinobu, about 150 miles NE of Tokyo. Certainly the largest battery of its kind in the world, it contains 4320 cells in series-parallel connection, made up of nine-cell units, sealed in acrylic resin, capable of producing 0.15 watt (2.7 volts at 55 milliamperes in series; 0.3 volts at 500 ma in parallel). The cells are mounted on a steel frame which faces south. Its angle of elevation varies from 33 deg above the horizontal in summer to 47 deg in the winter.

Charging current is supplied for three sets of nickel-cadmium storage batteries which in turn supply filament current at 6.5 volts and plate current at 60 volts for receiver tubes and 130 volts for transmitter tubes. Performance has been highly satisfactory. The only deterioration to be expected is discoloration of the acryl resin used to cover the cells. Use of one of the new sun-resistant transparent films should overcome this. Another large solar battery of similar design which will have 72 nine-cell units to charge five nickel-cadmium batteries is about to be used to operate a flashing beacon on an island in Tokyo Bay.

Instrumentation. Good work has also been done in developing electrically operated radiation-measuring apparatus. Both Gorszynski and Eppley-type solarimeters are now available from Eko Instruments Trading Company. The Electrotechnical Laboratory, Osaka Branch, has developed a new thermopile-type pyrheliometer which combines ruggedness with relatively low cost.

Special instrumentation for determining the daily variation in the amount of solar energy received in the ultraviolet and infrared bands as well as in the visible region has been developed by K. Sekihara and K. Kawamura of the Meteorological Research Institute. It includes an antimony-caesium photoelectric cell which sees the sun's light through a narrow-band filter, and an ingenious integrating actinometer. It is in commercial production by Toyo Rika Kogyo Instrument, Inc., of Tokyo.

Conclusion

Most of the future fuel requirements for Japan's 90,000,000 people and highly industrialized economy will have to be imported. Coal reserves are limited in quantity and low in quality. There is no indigenous oil or natural gas, but the automobile population is already large, and imported petroleum is playing an increasingly important part in the economy. Serious thought is being given to the use of nuclear power stations and these will undoubtedly form the backbone of the national power grid of the future.

Led by the Solar Energy Application Committee of the Japan Society of Mechanical Engineers, a good start has been made in developing simple and economical equipment which will enable the sun's radiation to supply a substantial part of the nation's low-temperature heat requirements.

Interested in Solar Energy?

The Executive Subcommittee of the Solar Energy Application Committee requests all ASME members who are interested in this field to communicate with the Secretary of the Committee, Dr. Peter E. Glaser, Arthur D. Little, Inc., 20 Acorn Park, Cambridge, Mass. The Committee plans to expand its activities, in view of the rapidly increasing interest on the part of the mechanical engineering profession in many aspects of solar energy. In order to accomplish this, the Committee needs to build up a mailing list of those who would like to participate in its activities. Please include company name and your position, as well as the nature of your particular interest in solar-energy applications.

By T. B. Hurst[1]

and

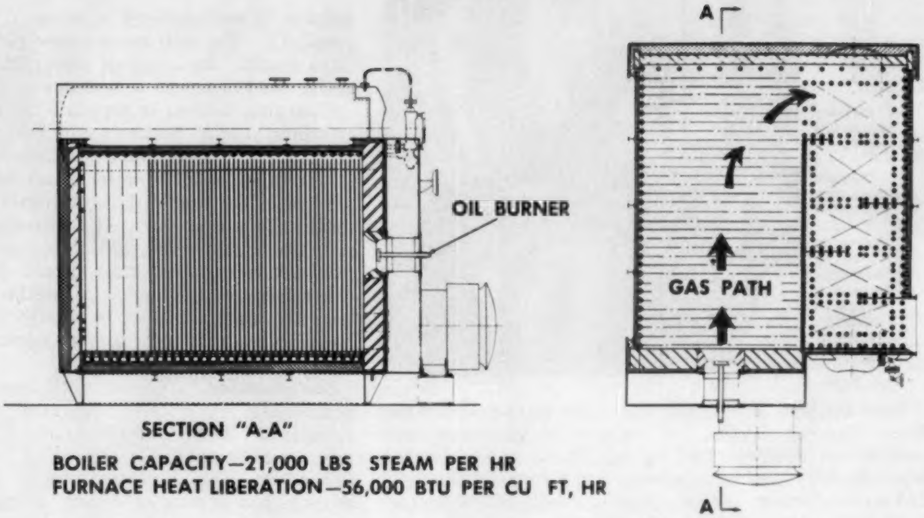
C. C. Hamilton,[2]

Mem. ASME

The Babcock &

Wilcox Company,

Barberton, Ohio



SECTION "A-A"

BOILER CAPACITY—21,000 LBS STEAM PER HR
FURNACE HEAT LIBERATION—56,000 BTU PER CU FT, HR

The advent of industrial boilers for specific fuels and fuel-burning equipment

INDUSTRIAL

Completely shop-assembled water-tube boilers, and field-erected units designed specifically for oil and gas firing, are leading to the rapid development of pressure firing, complete furnace water-cooling, and shop-assembled furnace components for many classes of industrial boilers. Burner designs have kept pace with these developments and are often tailor-fitted for particular furnace arrangements.

Coal-fired boiler designs likewise are being specifically developed to suit a particular method of firing. The stoker-fired designs encompass a variety of burning principles and grate designs. With each of these stokers, the furnaces must be adapted to different parameters.

Due to the high-temperature and high heat-absorption requirements for the furnace, design considerations must center in this area.

Oil and Gas Firing

For oil and gas firing, furnace configuration and construction are determined primarily by the space required to completely burn the fuel, with sufficient clearance between the burners and the heat-absorbing walls to minimize flame impingement; and to provide sufficient water cooling to protect the refractory, insulation, and casing material. Thus it is necessary to establish parameters which will define the combustion space and a satisfactory furnace construction.

Furnace Size. Fig. 1 illustrates a typical furnace shape for oil and gas-fired units. Furnace volume, and the related parameter, furnace heat liberation expressed in Btu per cu ft per hr, have no significant correlation in establishing the combustion space requirement—which varies not only with unit capacity, but also with furnace configuration.

The furnace heat liberation on modern oil and gas-fired boilers frequently varies from 30,000 to 100,000 Btu per cu ft per hr. This liberation value has no effect upon the peak wall-absorption rates, however, because the predetermined distance between the burner center line and adjoining side wall controls this factor.

Package boilers generally require long, narrow flame shapes due to the restricted lateral and vertical shipping requirements. The furnaces of field-erected boilers, on the other hand, are usually equipped with burners having shorter, bushier, flame shapes which permit utilizing a more cubical unit arrangement to better suit space requirements.

These shapes, as influenced by the burner's atomizer, throat, register, windbox, and impeller design, together with the furnace configuration, are the major determinants of furnace absorption rates and furnace life. Furnace heat liberation is of little significance in designing a unit to burn these readily ignited fuels.

The results of tests conducted on an industrial boiler

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[2] Design Engineer, Design Engineering Department.

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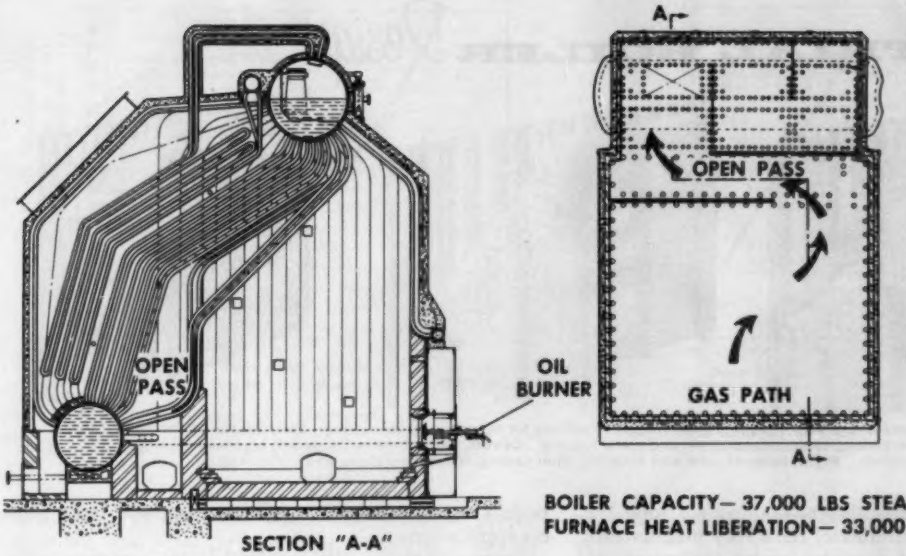

Fig. 1 Typical shapes for an oil or gas-fired boiler. The furnace and burner have been designed to burn the fuel adequately, without flame impingement on the walls.

has led to changes in the common boiler-design parameters

BOILER Design

to determine furnace heat-absorption rates are shown in Fig. 2.

Since furnace shapes must vary to meet design as well as arrangement requirements, the combustion space must provide for the necessary flame travel and the required side-wall clearances. Parameters for this purpose are furnace depth and heat release per ft of burner wall width per hr (per burner in the event of multiple burner rows). Together, these parameters will set maximum absorption rates and clearances between furnace walls and burner flame for circular, register-type burners. Typical values for these parameters, based on oil firing with local peak heat-absorption rates of 100,000 Btu per sq ft per hr, are shown in Table 1.

For gas firing or for oil firing with preheated air the preceding values can be increased 10 per cent. The relative ease in burning gas and the improved combustion with preheated air when firing oil permit this increase.

Furnace-Wall Construction. Due to the low ash content of oil and gas fuels, the amount of furnace heating surface and the type of wall construction for industrial boilers are established only by the acceptable service life.

The prime requisite for the furnace wall construction,

TABLE I

Furnace depth, ft	20	15	10
Heat release on burner wall (million Btu per ft wide, hr, burner row)	9.0–10.0	7.0–8.0	4.0–4.5

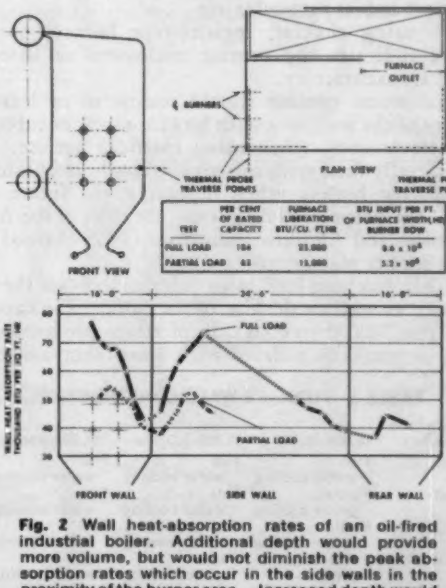

Fig. 2 Wall heat-absorption rates of an oil-fired industrial boiler. Additional depth would provide more volume, but would not diminish the peak absorption rates which occur in the side walls in the proximity of the burner area. Increased depth would not insure against carbon deposition on the side wall which results from liquid oil impingement and causes incomplete combustion.

INDUSTRIAL BOILER Design

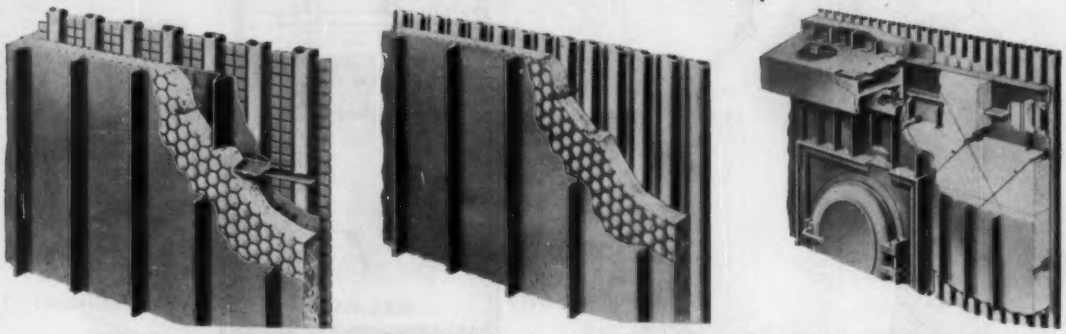

Fig. 3 The pressure-fired furnace. Three wall constructions for complete water cooling. **Left,** studded-tube wall showing inner casing, blanket insulation, and metal lagging. **Center,** membrane wall showing blanket insulation and metal lagging. **Right,** tangent-tube wall showing inner casing, block insulation, and metal lagging.

therefore, is to provide sufficient cooling for long life. In order to reduce, or eliminate, refractory maintenance, particularly in oil-fired furnaces, water cooling should be used to the fullest extent. The location and the amount of water cooling thus become the important criteria for good design. In the extreme this would include complete cooling of the furnace walls as well as the burner throats.

A common parameter used to describe furnace cooling is the furnace heat-release rate expressed in Btu input per sq ft of furnace heating surface per hr. The furnace heat-release rate, however, is the average in a given furnace configuration and thus does not define the quality of the cooling required in areas where peak absorptions occur. A better method of setting furnace-cooling requirements is to define the type of cooling required for various furnace walls, taking into account the size and complexity of the unit and its particular use.

When using circular, register-type burners our experience indicates the furnace enclosures as listed in Table 2 are satisfactory.

Partial water cooling should consist of at least $^1/_2$ coverage of the wall area with furnace tubes, or tubes and their attachments, when using extended surface. For units initially fired with oil, air cooling is acceptable on low-capacity boilers when designing for future coal firing. For purposes of definition, the rules of the American Boiler and Affiliated Industries (1958 Manual) are used to specify water-cooling areas.

Capacity has been used as an index to indicate the type of service as well as the size of the unit. The capacity range from 10,000 to 60,000 lb of steam per hr, for example, is generally satisfied with small shop-assembled

TABLE 2 FURNACE-WALL CONSTRUCTION

Boiler capacity (lb stm/hr)	10,000–60,000	61,000–100,000	101,000 and greater
Side wall	Full water cooling	Full water cooling	Full water cooling
Rear wall	Partial water cooling	Full water cooling	Full water cooling
Roof	Partial water cooling	Partial water cooling	Full water cooling
Front wall	Refractory or partial water cooling	Partial water cooling	Full water cooling
Floor	Air cooling or partial water cooling	Partial water cooling	Full water cooling

boilers used predominately for heating and light process applications.

Because of the usually low load factor, complete water cooling to protect refractory has not proved economical for this class of boiler. For the larger capacity boilers, however, there is need for increased water cooling. In most cases, the larger units are used for power generation at higher load factors and often are operated on a continuous basis. For this type of service, requiring reliability and low maintenance, complete water cooling should be employed.

The use of pressure-fired furnaces has spurred the use of water cooling as an economical matter, Fig. 3. When heated pressure casing is utilized to prevent casing corrosion, it is common practice to employ complete water cooling with the casing adjacent to the wall tubes. Pressure furnace constructions also can be accomplished by the use of welded membrane walls which recently have been employed on industrial boilers.

Coal Firing

When coal is fired by a stoker, consideration must be given to boiler arrangements which will permit use of a wide variety of coals and stoker types. The designs must also consider the furnace fouling and slagging problems created by coal ash.

For mass fuel-bed stokers (coal is burned solely on the stoker grate) the furnace configuration can be suited to the burning characteristics of the stoker for the particular coal involved. Ash and cinder carry-over from the furnace are at a minimum with this type stoker, thus posing no significant design problem with regard to erosion, ash collection, or stack emission.

Underfeed and chain-grate stokers are common types which fall into this category. The furnace plan dimensions are generally set to accommodate the stoker. Other characteristics which often affect the furnace configuration are reflective arches to promote combustion and provisions for side admission of combustion air to the stoker. These usually do not present serious design problems.

Design Parameters. Parameters which have proved significant in sizing furnaces are grate burning rates, burning rates per ft of boiler width, and furnace retention time for the combustibles. Grate burning rates

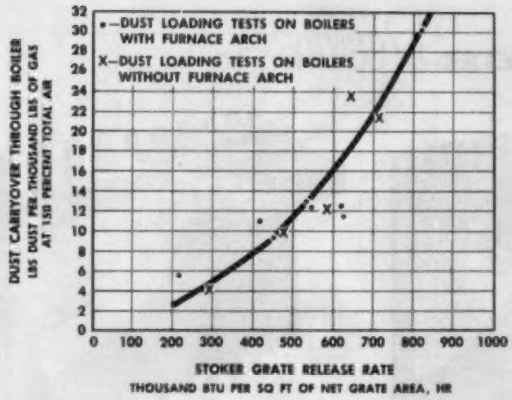

Fig. 4 Dust carry-over vs. grate release rate, a correlation using the Btu input per sq ft of grate area per hr as an index of the gas velocity in the combustion zone

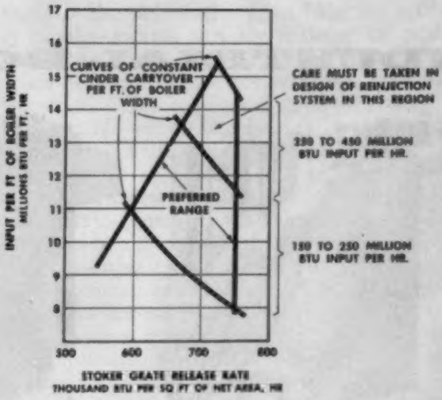

Fig. 5 Input per ft of boiler width vs. grate release rate. Care must be taken to design adequate cinder-collection, transport, and reinjection systems.

and burning rates per ft of width vary with the properties of the coal being fired and the particular stoker involved. These values will range from 300,000 to 500,000 Btu per sq ft of grate area per hr for mass fuel bed stokers.

Retention time, expressed as furnace liberation (Btu per cu ft per hr) becomes important when burning coal due to its relatively slow burning characteristics as compared with oil and gas. For mass fuel-bed stokers the furnace liberation should be limited to about 45,000 Btu per cu ft per hr. Once a furnace plan area is arranged to meet the stoker requirements, the necessary retention time or flame travel can be provided by furnace height or in some cases by an open pass, Fig. 1.

Coal-burning rates for the spreader-type stoker establish the plan section for a furnace in a manner similar to the mass fuel-bed stokers.

A furnace heat-liberation limit of 35,000 Btu/cu ft/hr used to define the furnace retention time for spreader-stoker firing is lower due to the suspension burning of the fine coal particles.

Thus furnace height can be established for a particular stoker grate by the preceding parameters. An open pass configuration, however, may be used in the lower-capacity range for this purpose. Regardless of furnace height, it is important that the rear furnace or bridge wall be at least 6 ft in height to prevent the throwing of raw coal into the boiler hoppers or into an open pass.

Reinjection. In addition to the combustion requirements, spreader-stoker furnace designs must consider fly-ash and cinder carry-over. The variables of coal type and sizing, cinder-reinjection systems, quantities of reinjection, grate design, and methods of operation have made the mechanics of cinder carry-over difficult to analyze. The authors' Company has conducted an extensive field-test program to determine, in part, the cinder and flue-dust loadings throughout boiler units. One of the basic configurations is shown in Fig. 9.

Investigations show that carry-over is primarily a function of the gas velocity in the combustion zone. Using the Btu input per sq ft of grate area per hr as an index of velocity, a correlation of these findings is shown in Fig. 4.

TABLE 3 TYPICAL RELEASE RATES

Spreader-stoker type	Heat-release rate (Btu/sq ft grate/hr)
Dumping grate	400,000 to 450,000
Reciprocating grate	450,000 to 650,000
Continuous ash-discharge grate	650,000 to 750,000

Coupled with grate release rate (Btu/sq ft/hr), the Btu input per ft of furnace width per hr is needed to determine the amount of cinder and flue-dust carry-over. A range of these parameters for trouble-free operation is shown in Fig. 5. The ratings are scaled to the unit capacity, permitting higher inputs per front ft on the higher-capacity units which have higher setting heights and lower furnace liberations to satisfy furnace heating surface requirements.

Spreader-stoker furnace design must also consider the necessary means for cinder reinjection, Fig. 6. For low-capacity units with narrow furnace widths it is often possible to provide for reinjection through the boiler side walls at the rear corners of the furnace. For most units, however, it is necessary to provide a means of distributing the fly ash uniformly across the width of the unit.

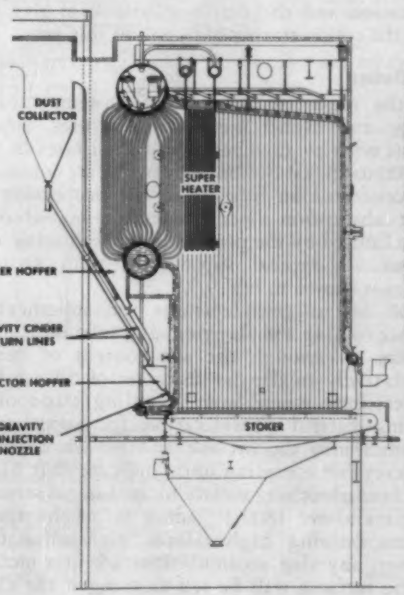

Fig. 6 A spreader stoker boiler with gravity cinder-rejection system. A pneumatic system may be used. When it is necessary to distribute fly ash uniformly across the width of the unit, a rear bridge wall is required.

INDUSTRIAL BOILER Design

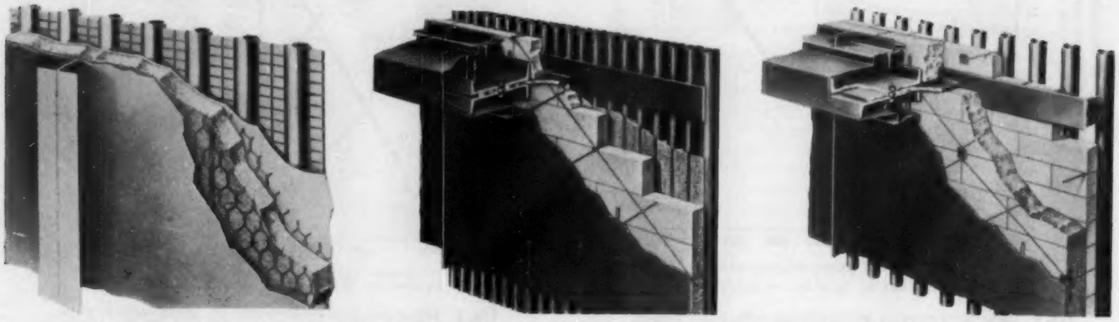

Fig. 7 Wall constructions for stoker firing. Major consideration would be the effective protection of furnace-wall refractory. **Left**, studded-tube wall showing asbestos board, blanket insulation, and metal casing. **Center**, tangent-tube wall showing refractory, block insulation, and metal casing. **Right**, water-cooled wall showing refractory, block insulation, and metal casing.

Wall Construction. The furnace wall for stoker firing must be designed with ample water cooling. An exception would be low-capacity heating boilers which are sometimes constructed with a refractory furnace to meet low-duty heating requirements in the capacity range up to 20,000 lb steam per hr where ample out-of-service time is available for refractory maintenance. Typical water-cooled wall constructions for stoker furnaces consist of water-cooled refractory and complete water cooling, Fig. 7.

A field survey of operating units led to the correlation shown in Fig. 8. Furnace release (Btu per sq ft per hr) and the ash-softening temperature, on a reducing basis, have been used as parameters for the purpose of describing furnace slagging and refractory protection. They are valid when used with the furnace sizes previously described. Any walls containing reinjection nozzles should always be completely water-cooled, regardless of the construction of the remaining walls, to eliminate refractory erosion and the corrosive attack of slag resulting from the concentration of fly ash in this area.

Superheater Design

To meet the needs of increased steam-temperature-control range and higher steam temperatures, superheater designs with average heat-absorption rates in the range of 15,000 to 18,000 Btu per sq ft per hr are common. This has necessitated an increase in the proportion of radiant heat absorption since convection-heat-absorption rates are limited by the permissible tube spacing and by draft loss. A typical superheater with radiant characteristics is shown in Fig. 9.

The major design considerations for superheaters involve surface fouling and slagging, and tube life.

Surface Fouling. Although the ash content of heavy fuel oil is relatively small, the character of oil ash has become increasingly worse from a fouling standpoint, thus requiring careful consideration for superheater design. Studies into the oil ash and oil-ash deposits plus field surveys of operating units indicate that high-temperature heat-absorbing surface located in gas streams at temperatures above 1800 F cannot be mechanically cleaned when burning high-sodium high-sulfur fuel oil. However, any slag accumulations are in a molten state, and the surfaces will be self-cleaning if the clear space between tubes is sufficient to prevent bridging and pluggage of the gas lanes with slag.

In the lower gas-temperature zones of the superheater, the problem of pluggage is still present. However, the deposits in this zone are of a nature that permit soot blowing for the control of slag build-ups, and improvement of heat transfer, if adequate clear spacing between tubes is provided.

A correlation based on average gas temperature, average steam temperature, and clear space between tubes is shown in Fig. 10.

In addition to the physical properties of the ash and the gas temperature, the clear spacing between tubes has an important effect upon superheater slagging and fouling in coal-fired units. For the gamut of bituminous coals used in industrial boilers, the furnace-liberation ratings shown in Fig. 8, in conjunction with the clear space between tubes shown in Table 4, give satisfactory superheater design parameters from a coal-slagging standpoint.

The predicted average gas temperatures leaving the furnace for a typical coal-fired boiler are shown in Fig. 8. When using these curves, it is significant to note that the average furnace-exit temperature is considerably below the coal-ash fusion temperature. There will be peak or unbalanced gas temperatures, however, which approach these values.

Superheater Metal Temperatures. The service life of superheaters is directly related to the tube-metal temperature of the worst tube or group of tubes in a particular section. In order to predict these metal temperatures, it is necessary to have a knowledge of the unbalanced flows and temperatures existing on the steam and gas side of the tube.

While it is possible to determine the unbalanced conditions on the gas side of superheaters, the steam side conditions generally are more significant and lend themselves more readily to analysis. A balance in the steam flow through individual tubes in a given steam pass can be obtained through the use of ferrules to increase the entrance loss and equalize the flow.

TABLE 4 SUPERHEATER TUBE SPACING

Average gas temperature	Clear space between tubes
1850 F	2"
2000 F	4"

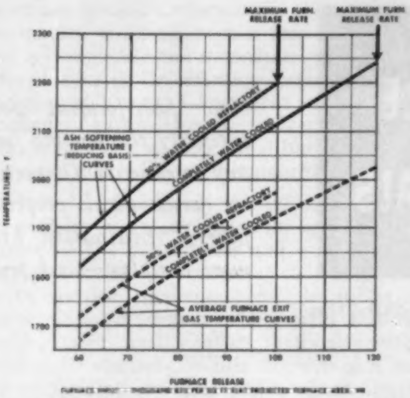

Fig. 8 Water-cooled refractory walls are never completely immune from attack by slag and ash erosion, but by designing to the limiting curve depicted, these difficulties are minimized or kept to a reasonable limit

A better method, however, is to design the superheater with sufficiently high-steam mass flows (lb of steam per hr per sq ft of flow area). This not only produces the necessary pressure drop to distribute the steam among the tubes but, equally important, establishes the velocity required to properly cool the tube wall. In this respect, it is often more economical to increase superheater pressure drop at the cost of higher pumping pressure if the increased pressure drop will permit use of lower-grade alloys in the superheater. A general guide for steam mass flows in the normal range of industrial boiler superheaters is shown in Table 5.

Boiler-Tube-Bank Design

The boiler-tube-bank design affords greater latitude in arrangement and design than the preceding components because of its location in a lower gas-temperature zone. Ash fouling, provisions for mechanical cleaning, and ash erosion are principal design considerations.

Surface arrangements and performance can vary to a considerable degree. The parameters of boiler rating and heat absorption per sq ft of total heating surface per hr have been used to describe the amount of surface and its absorption characteristics. Since 40 to 60 per cent of the heat absorption occurs in the furnace and superheater, these terms relate chiefly to the heat-absorption rates of low-duty boiler-tube-bank surface. This is the least important factor.

Within the scope of the limits listed in this section, the boiler tube bank should be sized to meet the efficiency requirements.

Clear space between boiler tubes should be at least 1 in. for gas temperatures in the range of 1100 to 1700 F for coal firing. Otherwise, the spacing requirements previously given for superheaters are adequate for boiler tube banks.

Provisions for soot blowers in the boiler tube bank are required unless clean natural gas or spreader-stoker coal firing is the only fuel. Lane blowing with soot-blower nozzles located directly in front of tube lanes requires a 2-in. clear space between tubes. If a 2-in. clear space between tubes is not available, mass blowing must be used. This requires a cavity between boiler banks to provide sufficient clearance between the soot-blower nozzles and the boiler tubes to minimize external erosion on tubes.

Cinder and Ash Erosion. Cinder and ash erosion of boiler tubes is a major concern with the high dust loading encountered when firing by spreader stokers. A single-pass boiler eliminates the basic cause of ash erosion, namely, concentration and stratification of the entrained ash due to baffles and turns in the boiler bank. For single pass boilers, average gas velocities of 65 fps have proved acceptable. For multipass boilers, all gas turns must be made in a cavity or idle pass of the boiler bank to reduce the concentration of ash particles, and the velocities must be reduced to a range of 35 to 50 fps.

For boilers followed by economizers and/or air heaters, the boiler exit-gas temperature should be limited to a maximum of 850 F, unless special flue and auxiliary equipment is considered.

TABLE 5 RANGE OF STEAM MASS FLOW VALUES

Steam temperature	Steam mass flow (lb per hr, sq ft of flow area)
Less than 750	75,000–150,000
700–800	250,000–350,000
800–900	400,000–500,000
900–1000	500,000–600,000

Bibliography

1 L. H. Coykendall and P. R. Loughin, "Boiler and Furnace Designed for Spreader-Stoker Firing," *Trans. ASME*, vol. 76, 1954, pp. 873–881.

2 J. B. McIlroy, E. J. Holler, Jr., and R. B. Lee, "The Application of Additives to Fuel Oil and Their Use in Steam-Generating Units," *Trans. ASME*, vol. 76, 1954, pp. 31–46.

3 P. R. Grossman and G. W. Kessler, "The Design of Boiler Furnaces for Combination Fuels." ASME Paper No. 55—SA-73.

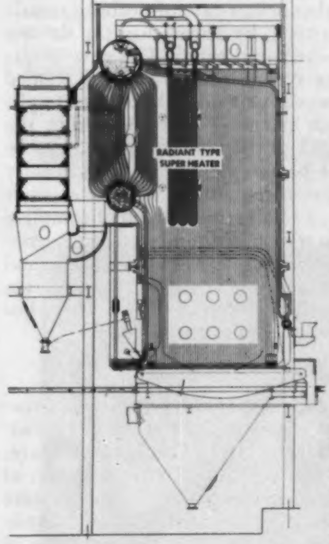

Fig. 9 A typical radiant-type superheater. To achieve increased radiant absorptions, superheaters must be located in higher gas-temperature zones, the shielding reduced, the tube spacing liberalized.

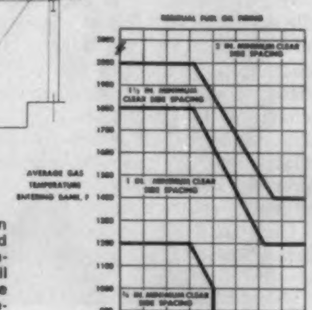

Fig. 10 Clear space between tubes vs. average gas and steam temperatures. Maintaining the limits shown will prevent pluggage of the gas lanes and permit mechanical cleaning of the surface in the zones where the ash has proper characteristics.

MECHANICAL PROPERTIES OF TEXTILE MATERIALS

New fiber-forming polymers intensify the demand for ways and means of characterizing the mechanical properties of fibers. Evaluation becomes more complex—and precise.

By E. J. Stavrakas, Fabric Research Laboratories, Inc., Dedham, Mass.

At one time the measurement of tensile strength and elongation to rupture dominated all physical investigations of textile materials. It soon became apparent that poor correlation existed between these physical data and end-use performance. Strong fibers frequently performed less efficiently than weak fibers; increasing the strength of yarns and fabrics, as demanded in civilian or military fabric specification, rarely solved the problem associated with the "weaker" material.

By way of contrast, in 1958 J. L. Barach, et al. [1],[1] in a paper on a technique for predicting the commercial acceptance of a fiber, listed fifty factors which could influence acceptance by the finished-goods merchant and the textile manufacturer.

From the physical testing point of view the past two decades have witnessed, in research activities, the replacement of traditional constant-rate-of-nothing tensile testers of the pendulum type, by tensile loading devices of the constant-rate-of-extension type. The new testers utilize a load-measuring system comprised of a bonded resistance-wire strain-gage type load cell with its amplifying equipment. With the new instrumentation the take-up and decay of load as the fiber is strained can be readily detected, and it becomes evident that virtually all textile fibers manifest three unique regions in their stress-strain curves, i.e., a small strain region of complete elasticity, a larger strain region of diminished dependence of load on strain, where the fiber seems to flow, and a final region, of varying extent, in which the stress and strain may or may not approach a Hookean relationship, but in either case the stress-per-unit strain increases.

One-Time Load to Rupture

In any discussion of the mechanical properties of textile materials or in the presentation of test data, the lead-off batter will be—tensile strength. This is unfortunate, since textile structures are rarely expected to perform at loads or stresses in the fiber comparable to its rupture tenacity. In general, it is anticipated that the textile structure will be subjected to repeated deformations of relatively low strain levels and it is desired that it will have the ability to recover from these deformations and return to its original state quickly and completely.

Of what value are the rupture tenacity and elongation data obtained from one-time load-to-rupture tests? One cannot discount the fact that the test is simple and can be performed quickly. Thus it is ideally suited for use as a quality control device. It is also valuable in determining the extent of damage occasioned by chemical and other treatments.

While the rupture properties are not of paramount importance in any but industrial end uses, there are certain features of the fiber which are discernible in the load-extension diagram (autographically recorded during the course of the test) that are useful in characterizing its mechanical properties, i.e., initial static modulus of elasticity, yield stress and strain, shape of the curve. It has been shown [2] that the initial static modulus of a fiber is one of the factors which determines the stiffness and draping qualities of the ultimate fabric structure. The energy of recovery from deformations of low magnitudes may be inferred, partially at least, from the initial static modulus of elasticity. A better estimate of this energy of recovery is found in the "Energy Index of Elasticity." However, special instrumentation is required for such determinations.

The tensile modulus of elasticity of a fiber is also important in characterizing the bulking qualities of a yarn produced from staple fibers. Assuming that the tensile and bending moduli of a fiber are equivalent—a valid assumption at low strains—then the ratio of torsional to bending moduli, an important factor in yarn bulking [3], may be inferred from the ratio of torsional to tensile moduli. The initial static modulus of elasticity of a fiber is determined from its stress-strain curve by normalizing the slope of the line AB, Fig. 1, for the dimensions of the sample.

The shape of the stress-strain curve along with the degree of uniformity in the rupture-elongation characteristics of the fiber are important fiber characteristics, since they are largely responsible for the extent of translation of fiber properties to yarn properties [4, 5]. In this connection such features as the direction of concavity, upward or downward, in the early portion of the curve and the character of its slope at stresses approaching rupture, play significant roles in determining the efficiency of translation.

Three Components of Deformation

The importance of the yield point as a measure of fiber performance may be more readily comprehended by consideration of the three components of deformation which may be discerned in materials exhibiting viscoelastic behavior. In this work they are defined, following Leaderman [6]:

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[1] Numbers in brackets designate References at end of paper.

Contributed by the Textile Engineering Division and presented at the Annual Meeting, Atlantic City, N. J., November 29–December 4, 1959, of The American Society of Mechanical Engineers. ASME Paper No. 59—A-99.

1 Immediate Elastic Deformation (IED), instantaneous deformation resulting from a load applied in zero time. It is completely and immediately recoverable.

2 Delayed Elastic Deformation (primary creep, I_{cr}), deformation which is time-dependent and recoverable.

3 Permanent Deformation (secondary creep, II_{cr}), deformation which is time-dependent but nonrecoverable. It is frequently referred to as "permanent set."

Below the yield point only two of these components, IED and primary creep, are generally operative. Hence the interest in the yield stress and strain. Materials with very low strains or stresses at the yield point (depending on the use conditions) will be subject to the deleterious effects of permanent set, other factors being comparable, more readily than materials with high yield strains or stresses. While fibers which manifest pronounced yielding are undesirable where dimensional stability of the structure is desired, they are advantageous in uses where knotting [7] or other deformations which induce high fiber-stress concentrations are indicated.

The yield point of textile materials is rarely as well defined as that of metals. Hence there are a number of techniques in use which facilitate locating a point on the stress-strain curve which may be regarded as the yield point. One of the more common methods of locating the yield point is to find the intersection of the stress-strain curve and a line bisecting the angle formed by the slopes of the initial and flow regions of the curve. The yield point may also be defined as the point in the flow region at which the minimum slope of the curve is initiated. In Fig. 1 the yield point, Y_1, was located by the first technique, and Y_2 was defined by the second.

All textile materials are sensitive in varying degrees to rate of strain. The magnitude of such fiber properties as initial static modulus of elasticity, yield stress, and rupture tenacity is dependent on the rate of strain at which the material is tested. With the available instrumentation, rates of strain ranging from 2×10^{-2} to 1.1×10^4 in. per min may be utilized in testing fibers. Extreme rates of loading and impact tests are quite useful in evaluating the potential processability of fibers during the various stages of spinning and weaving.

For impact studies, rates of strain in the order of 5×10^5 per cent per min may be utilized. In ordinary so-called static testing conditions, rates of strain up to 100 per cent per min are common. Generally, the selection of the desired rate of strain for testing single fibers is somewhat arbitrary, but it is restricted by the response of the recording equipment to avoid data which reflect the machine's characteristics rather than those of the test specimen.

Recognizing that variation in denier from fiber to fiber may be quite appreciable, particularly for fibers not too far removed from the experimental stage, it is the general practice to determine the denier of each fiber prior to testing. This is conveniently done by utilizing the phenomenon of resonance in transversely vibrating strings. If a string of length l and mass per unit length m is subjected to a tension T, it will resonate in transverse vibration at a fundamental frequency f given by:

$$f = \frac{1}{2l}\sqrt{\frac{T}{m}} \qquad (1)$$

This resonant frequency is determined on an instrument called a Vibrascope [8, 9] and, since l and T are known, m can be readily calculated.

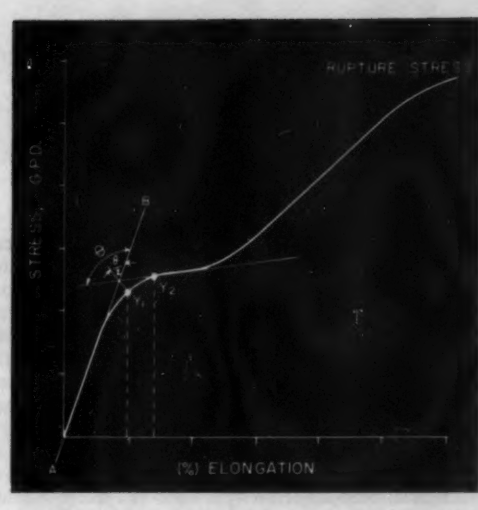


Fig. 1 Typical stress-strain curve of a viscoelastic material. While this simple, quickly performed test does not answer today's questions regarding a fiber, it is still a good quality-control device. The stress is in grams per denier.

Table I Per Cent Secondary Creep and Corrected Residual Elongation Characteristics of Various Commercial Yarns[a] Following Repeated Loading at 90 Per Cent of Average Rupture Stress

Material	Denier	Per cent secondary creep	Per cent corrected residual elongation
Viscose	150	5.5	5.0
Nylon	673	6.8	15.5
Orlon	190	11.3	8.5
Acetate	300	17.6	6.9

Data reproduced from E. R. Kaswell [10].

[a] Yarns had essentially zero twist, thus the effect of geometric form factors on creep and residual elongation is negligible and the data may be considered as representative of the properties of the fiber.

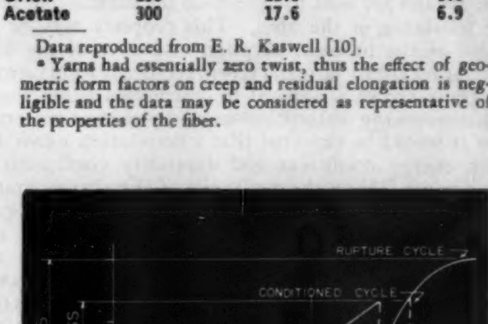


Fig. 2 Typical repeated-stress diagram. The magnitude of permanent set is important in determining the dimensional stability of a fiber.

MECHANICAL PROPERTIES OF TEXTILE MATERIALS

Repeated Stress

Considering that one of the requisites of a suitable textile material is the ability to recover from repetitive deformations, the magnitude of permanent set becomes an important criterion in evaluating the dimensional stability of a fiber. Moreover, materials possessing secondary creep will generally exhibit marked differences between their final cycle-to-rupture load-elongation diagram and the one-time load-to-rupture diagram (Fig. 2). One of the principal changes of concern to the textile technologist is the decrease in elongation to rupture of the conditioned fiber. It is important to have a measure of this elongation (per cent Corrected Residual Elongation) for the mechanically conditioned material, since a large change in this property reflects a substantial decrease in the energy absorption characteristics of the material. When a specific end use requires high elongation to rupture it is necessary to determine the magnitude of per cent CRE since the one-time load-to-rupture elongation will be misleading when a material possesses high secondary creep. The range of secondary creep and corrected residual elongation characteristics in certain commercial fibers is evident in the data of Table I [10].

Abrasion Resistance

In addition to the properties just discussed, repeated stress studies are used to determine the substantive abrasion resistance of the fiber. This property may be regarded as the inherent abrasion resistance of the fiber without regard to yarn and fabric geometric form factors. The resistance of a material to destruction is functional with the energy absorption capacity of that material. Thus it would be expected that a correlation exists between energy coefficient and durability coefficients.

In a paper [11] on the mechanics of abrasion resistance it was demonstrated that there exists a linearly proportional relationship between "energy coefficient" and "durability coefficient," Fig. 3. The durability coefficient is defined as the ratio of abrasion cycles to average per cent loss in strength, and is an index of the extent and rate of destruction. The energy coefficient is obtained from the ratio of the corrected residual elongation to the mean ordinate of the stress-strain curve of the mechanically conditioned cycle in which the ordinate has been adjusted to a unit basis to permit comparisons of materials of dissimilar strengths. The test specimen is mechanically conditioned by subjecting it to five cycles of repeated loading at 90 per cent of average rupture stress.

The term "abrasion" associated with the regression of energy coefficient on durability coefficient is not synonymous [12] with "wear." The term "abrasion" as used here connotes rubbing off or wearing away by attrition, and excludes all other destructive influences. Rubbing off or wearing away by attrition results in failure by rupture caused by the repeated application and removal of the destructive influence. Thus the energy coefficient is determined from the mechanically conditioned cycle of a material that has been subjected to repeated loadings at 90 per cent of rupture stress, and it reflects the influence in tension, at or near rupture values, of average modulus of elasticity, immediate elastic deformation, delayed elastic deformation, and nonrecoverable deformation.

Repeated Strain

The ability of a fiber to recover its size and shape after deformation is a vital property of any textile material. The ranking of textile structures of the same geometry is functional with the elastic behavior of the fibers of which they are comprised. Although the performance of the most desirable fiber from an elastic behavior standpoint can be severely depressed by improper selection of fabric construction, a fiber manifesting poor elastic behavior can hardly be raised to a performance level above that potentially available from its inherent properties, even with the best possible fabric design. Consequently, it is germane to the problem of fiber evaluation to obtain a substantial fund of knowledge relative to the recovery properties.

There are almost as many ways of characterizing the recovery properties of a fiber as there are investigators in this field. The culprit in this matter of recovery is—time. Once a fiber has been strained it requires a considerable length of time to make its recovery. In attempting to obtain the necessary information about recovery in a reasonable time, various workers [13, 14, 15] have used a variety of techniques. This creates a problem in comparative evaluation of this fiber characteristic, since the published data for many of the currently available materials have been gathered in a variety of ways, thereby confounding any attempt to compare fibers examined by different investigators. Techniques notwithstanding, the basic concept of elastic recovery is to express the recoverable (within the time limits of the test) deformation as a per cent of the total deformation.

Pulse Propagation

How do textiles perform under the wide range of stress conditions to which they are subjected, if a yield point is reached at low stress concentrations? It would seem that textiles could not be rendered dimensionally stable, if the concept of yield points taken from classical mechanics has any validity.

Clarification of the apparent conflict between experience and theory comes from two new areas of understanding:

1 Analysis of the distribution of destructive forces under service conditions indicates that very rarely is any one fiber within a composite textile structure subjected to an average strain of more than 5 per cent, and much more frequently these averages are of an order of magnitude of 2 to 3 per cent.

2 Further analysis of the stress-strain curve presents clear evidence that the deformation depicted by the total curve is the sum of the three components of deformation described above, two of which are time dependent.

Thus by introducing the factor of time in all considerations of textile performance, and keeping in mind the low strains under which individual fibers perform, an important extension was made in our understanding of what to look for when initiating a study of any textile fiber or its products.

A Pulse Propagation Meter

In consideration of the low strains to which fibers are subjected, the percentage of perfect elasticity evidenced by the fibers, while small in relation to total elongation, becomes a significant contribution to their elastic performance. An instrument known as the Pulse Propagation Meter was developed by Fabric Research Laboratories, Inc., and the Magnetic Amplifier Corporation.[3] This device triggers sonic pulses at the rate of 160 per sec, and these pulses are transmitted to the specimen by means of piezoelectric crystals. The time for an individual pulse to be propagated a given distance through the specimen to a receiving crystal is precisely indicated by the device which autographically produces a diagram relating propagation time to strain as the specimen is loaded in the Instron tensile testing instrument.

Thus with velocity of longitudinal pulse propagation through the specimen determined by the pulse propagation meter, the dynamic modulus of elasticity or its reciprocal, the compliance, may be readily determined under static or dynamic loading conditions by the following expression:

$$E = \rho v^2 \tag{2}$$

where

E = dynamic modulus of elasticity
ρ = specific gravity of the material
v = velocity of pulse propagation

The units of E in the above equation are those of force per unit cross-sectional area per unit strain. Since in textile fiber studies the unit force dimensions are more conveniently expressed in terms of force per unit weight per unit length of fiber, i.e., grams per denier, the equation was modified to express the modulus in grams per denier per unit strain dimensions. The equation thus becomes:

$$E\ (gpd/\text{unit strain}) = (1.1136 \times 10^{-9})\ (v^2) \tag{3}$$

where

v = velocity of pulse propagation (cm/sec)

The immediate elastic deformation is defined mathematically as:

$$\text{Immediate Elastic Deformation (IED)} = \int_0^{\sigma} \frac{d\sigma}{E} \tag{4}$$

The load versus compliance (I/E) diagram, Fig. 4, affords the means of determining the immediate elastic deformation for whatever stress is desired. Having a curve with the load per denier (σ) as the ordinate and the reciprocal of the instantaneous modulus of elasticity ($1/E$) as the abscissa, the integrand in equation (4) is seen to be the differential element of area. Hence the immediate elastic deflection corresponding to a given stress or strain may be calculated from the area under the stress versus $1/E$ curve up to the stress in question. A more detailed presentation of the derivation of IED is presented in Hamburger's work [16].

Recognizing that below the yield point only two deformation components (immediate elastic deformation and delayed elastic deformation) are present, the extent of perfect elastic behavior, in dealing with this portion

[3] Current name, Janszen Laboratory, Inc.

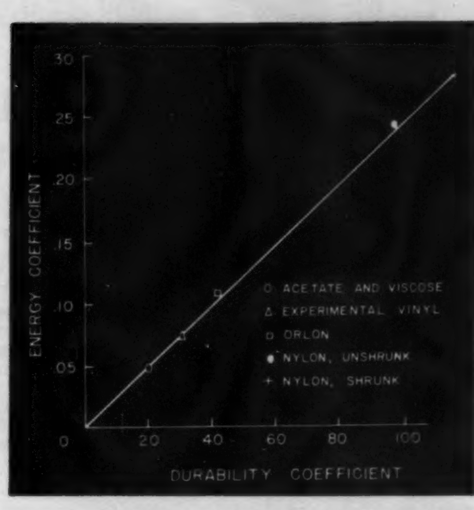


Fig. 3 The fiber's durability in relation to its ability to absorb energy. "Durability coefficient" is the ratio of abrasive cycles to average per cent loss in strength.

Table 2 Deformation Index of Elasticity of Several Commercial Textile Fibers and Yarns[a] at Various Strain Levels

		Strain level		
Material	Denier	1%	3%	5%
Mohair	16.5	1.00	0.79	0.51
Wool	17.0	0.83	0.62	0.39
Silk	17.5	0.81	0.57	0.39
Dacron	210[b]	0.81	0.56	0.54
Acetate	300[b]	0.73	0.47	0.29
Nylon	210[b]	0.59	0.41	0.38
Orlon	200[b]	0.57	0.33	0.22
Viscose	150[b]	0.50	0.20	0.14

[a] Data reproduced from Hamburger, Platt, and Morgan [17].
[b] Yarns had essentially zero twist, thus the effect of geometric form factors on this index is negligible and the data may be considered as representative of the properties of the fiber.

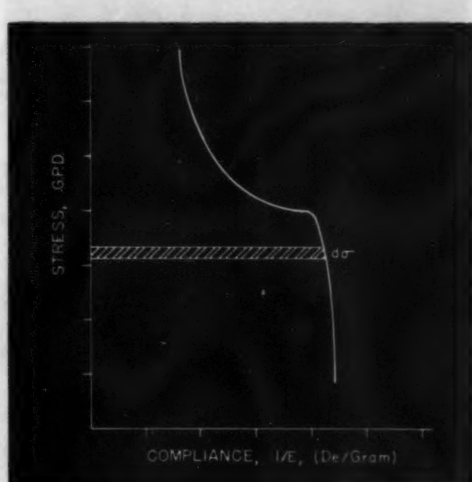


Fig. 4 Typical stress vs. compliance diagram. The stress is in grams per denier. Abscissa is the reciprocal of the instantaneous modulus of elasticity.

MECHANICAL PROPERTIES OF TEXTILE MATERIALS

Table 3 Energy Index of Elasticity of Several Commercial Textile Fibers and Yarns[c] at Various Strain Levels

Material	Denier	Strain level 1%	3%	5%
Mohair	16.5	1.00	0.72	0.39
Wool	17.0	0.84	0.53	0.27
Silk	17.5	0.81	0.46	0.28
Dacron	210[c]	0.81	0.50	0.51
Acetate	300[c]	0.73	0.37	0.19
Nylon	210[c]	0.59	0.41	0.38
Orlon	200[c]	0.57	0.25	0.15
Viscose	150[c]	0.51	0.14	0.09

Data reproduced from Hamburger, Platt, and Morgan [17].
[c] Yarns had essentially zero twist, thus the effect of geometric form factors on this index is considered negligible and the data may be considered as representative of the properties of the fiber.

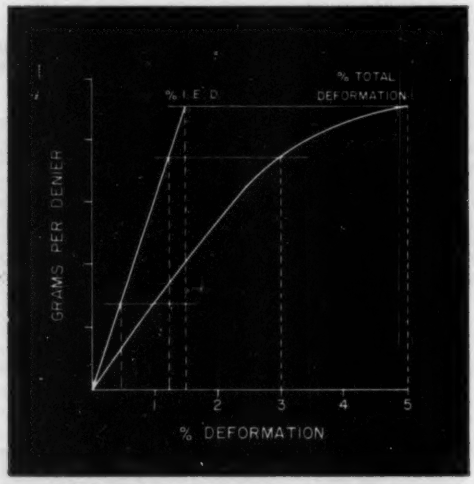


Fig. 5 "Energy Index of Elasticity" is the ratio of the areas under the two curves. (IED—immediate elastic deformation). A listing of these ratios is given in Table 3.

of the curve, may be represented by the ratio of the immediate elastic deformation to the total deformation at any load or strain equal to or less than the yield load or strain. This ratio of IED to total strain may be regarded as a "Deformation Index of Elasticity" since it sets forth the extent of perfect elastic response of the specimen as a percentage of the total deformation suffered. Table 2 contains data on the Deformation Index of Elasticity for several commercially available fibers at various strain levels.

Recovery From Deformation

In the process of recovering from deformation, a sufficient quantity of strain energy must be released to cause a complete recovery of the individual structural elements themselves, and, in addition, to overcome the resistance of the gross structure comprised or such elements. The ratio of the strain energy derived from the immediate elastic-deformation component to the total strain energy derived from the total deformation may be regarded as an "Energy Index of Elasticity." It sets forth the extent of immediate and complete strain energy released as a fraction of the total available at any given strain. Such a ratio is obtained by dividing the area under the load versus IED curve by the area under the load versus total deformation curve, Fig. 5. A listing of the "Energy Index of Elasticity" of several commercial textile fibers at various levels of strain is contained in Table 3. It is interesting to note that the ranking of elastic behavior for these fibers at 1 per cent is not maintained at the higher levels of strain. The shift in ranking is largely attributable to differences in yield strains. Fibers with high yield strains tend to maintain their elastic characteristics over a wider range of strain levels.

Conclusion

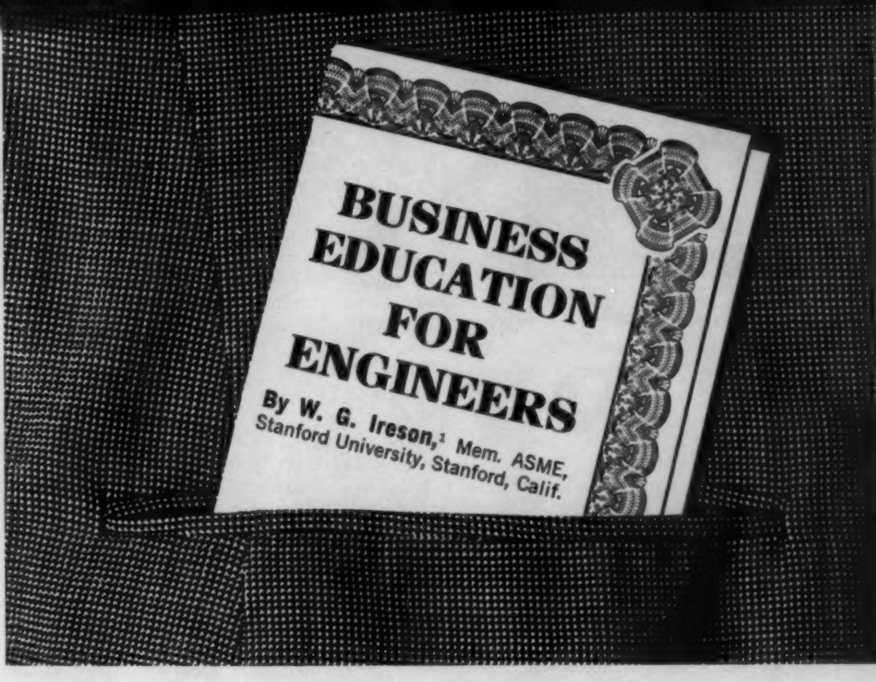
A few of the techniques applicable to the characterization of the mechanical properties of fibers have been discussed. Others are available, and the quest for new techniques continues.

Acknowledgment

The author expresses grateful appreciation to Dr. W. J. Hamburger for his personal interest and helpful recommendations.

References

1 J. L. Barach, R. G. Stoll, and A. F. Tesi, "Predicting Commercial Acceptance of a Fiber," *Textile Research Journal*, vol. 28, September, 1958.
2 C. C. Chu, W. J. Hamburger, and M. M. Platt, "Determination of the Factors Affecting the Draping Properties of Cotton Fabrics," Fabric Research Laboratories, Inc., unpublished Research Report No. 966.
3 A. B. D. Cassie, "Characteristics for Warmth in Underwear Fabrics," *Journal Textile Institute*, vol. 40, May, 1949.
4 K. R. Fox, "Engineering Aspects of Textile Structures," *American Dyestuff Reporter*, vol. 45, May, 1956.
5 M. M. Platt, W. G. Klein, and W. J. Hamburger, "Mechanics of Elastic Performance of Textile Materials, Part IX: Factors Affecting the Translation of Certain Mechanical Properties of Cordage Fibers Into Cordage Yarns," *Textile Research Journal*, vol. 22, October, 1952.
6 H. Leaderman, "Elastic and Creep Properties of Filamentous Materials and Other High Polymers," Textile Foundation, Washington, D. C., 1943.
7 M. M. Platt, "Factors Affecting Knot Strength," Fabric Research Laboratories, Inc., unpublished Research Report No. 565.
8 V. E. Gonsalves, "Determination of Denier and Strength of Single Fibers by Vibrascope and Heim Tensile Tester," *Textile Research Journal*, vol. 17, July, 1947.
9 D. J. Montgomery and W. T. Milloway, "The Vibrascope Method for Determination of Fiber Cross-Sectional Area," *Textile Research Journal*, vol. 22, November, 1952.
10 E. R. Kaswell, "Textile Fibers, Yarns, and Fabrics," Reinhold Publishing Corp., 1953.
11 W. J. Hamburger, "Mechanics of Abrasion of Textile Materials," *Textile Research Journal*, vol. 15, May, 1945.
12 H. J. Ball, "Problems Which Abrasion and Wear Testing Present," *Textile Research Journal*, vol. 9, February, 1938.
13 R. Meredith, "A Comparison of Tensile Elasticity of Some Textile Fibers," *Journal Textile Institute*, vol. 36, T147, 1945.
14 G. Susich and S. Backer, "Tensile Recovery Behavior of Textile Fibers," *Textile Research Journal*, vol. 21, 1951.
15 L. F. Beste and A. M. Hoffman, "A Quantitative Study of Resilience," *Textile Research Journal*, vol. 20, July, 1950.
16 W. J. Hamburger, "Mechanics of Elastic Performance of Textile Materials, Part II: Application of Sonic Techniques to the Investigation of the Effects of Visco-Elastic Behavior on the Stress-Strain Relationships of Certain High Polymers," *Textile Research Journal*, vol. 18, December, 1948.
17 W. J. Hamburger, M. M. Platt, and H. M. Morgan, "Mechanics of Elastic Performance of Textile Materials, Part X: Some Aspects of Elastic Behavior at Low Strains," *Textile Research Journal*, vol. 22, November, 1952.



Economics in engineering education? This chapter from a recent book discusses current trends. A study of university-college program in business administration.

The opportunities for engineering students to obtain some business education as undergraduates vary greatly with the type of college or university. Within most of the engineering colleges there are some limited opportunities. Where the engineering college or school happens to be part of a university, there are usually greater opportunities.

The Engineers' Council for Professional Development, the accepted accrediting agency for engineering curriculums, has exerted a powerful influence on the amount of general studies or humanities required in engineering colleges. While the intent of the ECPD was not to force these schools to require business training, some schools have used such courses as principles of economics, psychology, business law, sociology, industrial relations, report writing, and organization to satisfy their minimum requirements in the humanities. Most ECPD inspectors refuse to accept all of them as "humanities," but we would not argue the fact that all these courses contribute to the business education of the student. They certainly contribute to the student's understanding of the business world, personnel problems, and the social responsibilities of the businessman.

Accredited by ECPD

Most of the undergraduate engineering curriculums accredited by ECPD will contain 15 or more semester units (or their equivalent number of quarter credits) of the 120 semester units required for graduation in some of these areas. The real value of these courses depends to a great extent upon the schools in which they are offered. Unfortunately, when these courses are offered within the engineering schools, there is a tendency to have the courses taught by teachers who would not be considered for appointment in top quality schools specializing in these areas. The courses are very likely to be taught "from the book" with little enthusiasm or imagination, and, consequently, without stimulating the students to do more than "pass the course." Those schools which are fortunate enough to have these courses available in liberal arts colleges or university colleges usually find a higher degree of enthusiasm on the part of the students for the courses and, as a result, greater benefit from the exposure.

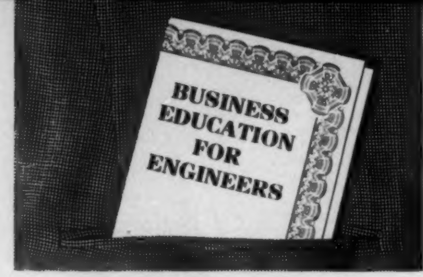
The majority of the engineering schools in this country now require the engineering student to take at least one course in the principles of engineering economy. A recent survey[2] revealed that approximately 9000 students enroll in this course each year in the nation's colleges. Its popularity has grown from recognition of its value as preparation for making sound business decisions. The subject matter of this course is applied economics with special emphasis on the formulation of the problem, the determination of the alternatives available, and the evaluation of differences among the alternative solutions. For many engineering students this course is their first and only college exposure to the economic necessities of business, but it can become a powerful tool in the hands of the ambitious student.

Those schools that offer a curriculum in industrial engineering usually offer the largest number of opportunities for business education. The number of industrial engineering curriculums has increased quite rapidly since

[1] Professor and Executive Head, Department of Industrial Engineering.

Condensed from "The Education of the American Business Man," by Frank C. Pierson, Professor of Economics, Swarthmore College, and others. W. Grant Ireson wrote Chapter 19 which is condensed here. The book was published by McGraw-Hill Book Company, Inc., New York, N. Y., Oct. 26, 1959.

[2] A survey made by Gerald Matchett of the Illinois Institute of Technology for the Engineering Economy Division of the American Society for Engineering Education, to be published in *The Engineering Economist*, vol. 4, no. 2.



1943. In 1943, there were only 19 accredited industrial-engineering curriculums or options in other curriculums. In 1949 there were 23 accredited curriculums or options, and in 1957 there were 49.[3] Undergraduate enrollment in industrial engineering has grown from 2303 in 1939, and 1465 in 1946 to 5991 in 1956–1957.[4] The growth has been the result of a number of important factors, but certainly one of the most important was the desire of engineering students to obtain the fundamentals of engineering (without any extensive specialization in one engineering field) together with a sound introduction to management and business practices.

There is no question but that part of the growth in the enrollment in industrial engineering was the result of the transfer of students from other engineering curriculums to industrial engineering in the hope of finding an easier degree. Most departments of industrial engineering recognized this problem long ago and took steps to prevent a continuation of the practice. One development has been the introduction of rigorous courses to replace descriptive, survey-type courses, and this has been especially true in the courses that tend to overlap or duplicate undergraduate business administration courses. Practically all industrial-engineering departments offer and/or require courses in business or industrial organization, industrial management, production, inventory or materials control, industrial relations or personnel administration, accounting, and cost control or budgeting. Depending upon the availability of schools of business administration or economics, these courses may or may not be offered by the industrial-engineering faculty.

A New Trend

Within the last three or four years a new trend has been developing which promises to make more opportunities for business education available to engineering students. A number of engineering colleges have introduced "administration options" into the regular mechanical, civil, electrical, and chemical-engineering curriculums. Stanford University, Michigan State University, and the University of Illinois are a few of the colleges making this type of program available. These options usually permit the student to substitute ten to fifteen semester units of business or industrial-engineering courses from an approved list for an equal number of units of the more advanced specialized courses within his major department. The objective of this program, as stated by a number of department heads, is to prepare the engineering student who has no interest in research or design for a career in the administration of engineering work. It must be recognized immediately that this program is similar in nature and intent to the established industrial curriculums and, in a few cases, requires as much work in the managerial fields as the industrial-engineering curriculum. These programs have a stronger appeal to some students than industrial engineering has, and a few companies have shown special interest in graduates of such programs. Joining a limited amount of management education to an established curriculum offers some definite advantages, but there is the hazard that this portion of the curriculum will be a superficial coverage and, consequently, mislead the student as to his qualifications for managerial positions.

Other Programs

A few engineering colleges provide opportunities for business education in programs that are slightly different from the usual industrial-engineering programs. These curriculums are given such names as Business and Engineering Administration, Administrative Engineering, Industrial Management, Industrial Administration, and Engineering Administration. Dartmouth College, Illinois Institute of Technology, Washington University, Rutgers University, University of Tennessee, Rensselaer Polytechnic Institute, and Yale University have used these or similar titles. Some of these programs are accredited by the ECPD as industrial-engineering curriculums, provided they meet all the requirements for the basic sciences, mathematics, engineering fundamentals, and humanities.

The other types of programs (i.e., industrial management) usually require some basic work in engineering but not more than do the normal freshman and sophomore years. The other two years usually resemble the last two years of the usual undergraduate business-administration curriculums. These curriculums are not accredited by the ECPD and are not presented as "engineering" curriculums. They do, however, provide a specialized type of business education for the young man who has some tendency toward technical work but perhaps neither the capability nor interest in pursuing a regular engineering degree. The enrollment records of a few colleges where such programs are available show that a fairly large percentage of the graduates of these curriculums started in engineering and transferred. Interviews with faculty and administration officials of two such schools revealed that these students tended to be among the lower third or lower half of their class at the time of admission.

There is no definite pattern as to where the student obtains the business courses in these specialized curriculums. In some cases, such courses as accounting, marketing, personnel administration, and organization and management are provided by the business or commerce schools. In other cases, these are taught in the parent department or school, such as the School of Industrial Management. In still other cases, some of these courses are obtained from the industrial-engineering department. It seems almost impossible to draw any valid conclusions regarding the benefit of having one source versus the others. The value of the courses seems to depend most heavily upon the teacher and not upon the department or school in which he is located.

Schools Within a University

An objective toward which effort should be exerted is a better basis for assigning areas of instruction to various schools within a university. Possibly one of the better bases would be to have courses that are based upon mathematics and science taught in the engineering schools with the traditional management functions taught in business administration.

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[3] Data extracted from annual reports of the Engineers' Council for Professional Develoment.

[4] Data extracted from annual issues of "Engineering Enrollments and Degrees," U. S. Department of Health, Education, and Welfare, Office of Education.

ANNUAL REVIEW

PLASTICS DEVELOPMENTS

review of the literature for the year.. 1958-1959

5.8 billion pounds of plastic! That's the estimate for the year 1965. Here are the current developments, some of them startling, that point to this acceptance of plastics

By Lois W. Brock, Research Library, The General Tire and Rubber Company, Akron, Ohio

A REVIEW of developments in 1957–1958 was presented before the annual meeting of the Society last year and subsequently appeared in MECHANICAL ENGINEERING [1].[1] Each year the January issue of *Modern Plastics* features high lights of the previous year. One review surveys improvements in processing, materials, and standards and furnishes an extensive bibliography [2]. Another stresses engineering advances [3]. A third studies the markets for all types of plastics and gives a breakdown of consumption by end uses [4]. A summary of new engineering uses for plastics stems from 100 papers presented at the annual meeting of the Society of Plastics Engineers [5].

New titles have appeared. *German Plastics Digest*, now an integral part of *Kunststoffe*, presents English language versions of the important papers in each issue of that periodical [6]. A new British publication stresses applications of plastics [7] which are also to be featured in a sister publication of the *Journal of Polymer Science* [8]. Advances in polymeric materials are carried in German and in English in one new magazine [9] and new adhesives in another [10]. A new book describes the seven new primary plastics of 1958 and also includes recent improvements in established plastics [11].

Materials

A useful guide to the 19 main types of plastics includes summaries of properties, forms, and costs; simple ways to identify them; forming and converting techniques [12]. A broad look at new materials has been provided [13] and a guide to materials selection for plastics moldings [14]. A new primary component for foams which looks like free-flowing, white sand, actually consists of small glass spheres which can be bonded with organic or inorganic agents to give foam materials [15].

[1] Numbers in brackets designate References at end of paper.

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Acetals. "Acetal resin" has been proposed as a generic term to describe high polymers derived from formaldehyde and composed of repeating oxymethylene units [16]. Late in the summer of 1959, du Pont began selling Delrin which it had been giving away for three years for evaluation [17]. This material, which is 80 per cent lighter than zinc and 20 per cent lighter than aluminum, has strength properties which approach those of metals. It has been suggested as a replacement for nonferrous castings [18, 19, 20]. Thermal stability of the high-molecular-weight material has been improved considerably during the years of development, with further improvements promised through esterification [21]. Melting point, stiffness, and tensile strength of these materials exceed those for linear polyethylene [22]. Phenolic compounds are the most effective solvents, but only at temperatures of 50 to 100 C. The resin was not soluble at room temperature in any of the hundreds of solvents or solvent systems tested [23]. An evaluation compares Delrin with two other tough rigid thermoplastics; viz., Lexan and Pro-fax [24].

Epoxies. The use of diepoxides and anhydride cures has afforded materials with higher heat-distortion temperatures, better electrical characteristics and easier workability [25, 26, 27]. Various curing systems have been studied for flexibilizing epoxy castings [28]. Epoxy foams offer a combination of physical, chemical, and electrical properties which make them useful for thermal insulation, electrical components, life preservers, encapsulating materials [29]. New volume markets are materializing in highway and building applications [30].

Vinyls. A whole range from rigid, high-impact-strength materials to soft, flexible products is available through blending PVC with chlorinated polyolefins. Compounds are easily modified to suit individual applications [31]. Sound velocity and damping factor at temperatures from 70 to 120 C and at frequencies from 1 to 10 kHz have been measured in plasticized samples of PVC [32]. Vinyl-metal laminates provide high decorative appeal, strength, light weight, and ease of fabrication along with resistance to abrasion and to the corrosive action of most

PLASTICS DEVELOPMENTS

chemicals [33, 34, 35]. They are being used widely for radio and TV housings, as cabin paneling in the Boeing 707, for boat docks, luggage, and table tops. U. S. Rubber has licensed Ford for the Marvibond continuous process. Ford used the laminate extensively in its 1959 Thunderbird interiors [36]. Problems of heating the adhesive and fabricating these laminates have been discussed [37]. A significant development has been large-scale production involving coating of steel with a liquid plastisol, curing, and embossing [38, 39]. A magnetic-force welding system has been developed for joining this new material [40]. The Vinyl-Metal Laminators Institute, organized in 1957, will now function as a Division of the Society of the Plastics Industry [41]. Seven companies represented have already prepared specifications for these products.

A vinyl foam of very fine, uniform cell structure, low density and low-compression set has been made using sodium borohydride plus water in a slightly acid medium. The process is excellent for small, intricately molded parts [42].

Polyurethanes. A review of recent developments in this field refers particularly to continuous production of polyether-urethane foams [43]. Another comprehensive review covers the basic chemistry, formulations, chemical and physical properties and applications of rigid foams [44]. Thermal-conductivity values, heat and fungus resistance are tabulated for rigid foams [45] and thermal conductivity for flexible foams [46]. The importance of adhering to a process exactly as prescribed is stressed in one article which gives practical information on cavity design, temperatures of pouring, mixing times, and the heat-cure cycles [47]. Urethane foams made from different proportions of tolylene diisocyanate and castor oil vary in final foam density, shrinkage, tensile strength, ultimate elongation, and compression modulus [48]. Useful modifications of urethane foams have been obtained in experiments utilizing variously sized and coated glass fibers [49]. Difficulties encountered in earlier molded articles of urethane foam, e.g., skin coarseness, cellular irregularity, nonuniformity of density, hard edges, surface marking, and slow recovery from deformation have been corrected by new methods [50]. A new system for room-temperature curing of polyurethane adhesives involves the use of an aromatic diamine dissolved in a glycidyl ether. The ether acts both as solvent for the diamine and as a possible reactive modifier for the polyurethane [51].

Polycarbonates. Applications of this new material based on its transparency, heat resistance, dimensional stability, and high impact strength are seen in camera cams, light diffusers for aircraft instruments, electrical connectors, lens caps, terminal blocks in electronic equipment, ball bearings, control disks, and housings for electronic and electrical devices [52, 53]. Practical operating data on injection molding, extruding, machining, finishing, and bonding this resin have been supplied [54, 55]. Extensive data are given in a comparison of Lexan with other tough thermoplastics [24]. Polycarbonate resins will be available commercially toward the end of 1960 when General Electric's plant is completed. Price of the semicommercial material runs from $2.35 to $2.75 per lb.

Polypropylene. Properties, production, and applications of various forms of this new polymer are considered in detail [56, 57, 58]. Its permeability to gases and vapors is discussed [59] and factors affecting the problem of shrinkage during processing [60].

Polyethylene. Much information on this widely used polymer is available. Some articles tabulate physical properties [61, 62] or give detailed data for estimating life expectancy [63]. Attention has been paid to the problem of stress-cracking [64, 65, 66]. Four round-robin tests conducted by a committee of the American Society for Testing Materials formed part of a major revision of the specification for polyethylene molding and extrusion materials [67]. There is further information on crystallinity and embrittlement [68, 69, 70] and on thermal antioxidants for polyethylene containing carbon black [71, 72].

Ground rules are given for molding to overcome internal stresses [73] and techniques for extrusion of clear film from high-density polyethylene [74]. Methods for pretreatment of polyethylene to make it more printable are described in some detail [75].

Preliminary tests have shown that marine growths hardly attack polyethylene. Wooden boat hulls have been protected on this basis [76]. An excellent filter medium for use with strong alkalis and hydrofluoric acid [77] is 80–100 mesh polyethylene powder. Foamed polyethylene has been used successfully as dielectric material for coaxial cables [78]. Residual molding strains and service behavior of various pieces of household ware are described [79].

Polyethylene Terephthalate. Data on hydrolytic degradation of Mylar and Dacron make it possible to estimate the minimum time for these materials to reach a given degree of degradation at any chosen temperature or humidity [80].

Polystyrene. In spite of its enormous volume of use, less is heard today about polystyrene than about the new polyolefins, polyester, and so on. However, it should be possible to raise the temperature of deformation to 180 F by application of stereoblock techniques giving isotactic or syndiotactic forms [81]. A comprehensive review covers material types, factors affecting physical properties, stress considerations, and injection-molding design principles for polystyrene [82]. Sound velocity and damping factor from 70 to 120 C and at frequencies from 1 to 10 kHz have been measured in polystyrene [92].

Fluorocarbons. Frictional properties of Tetrafluoroethylene resins have been discussed [83]. Fluorosint, a reinforced fluorocarbon, shows two to four times the dimensional tolerance of molded parts over unmodified PTFE. Its thermal coefficient of expansion is $^1/_{18}$ that of Teflon [84]. Fluorocarbon combined with polyester is used in 10,000-psi helium valves because it is impervious to helium, is self-lubricating, and has a low coefficient of friction [85]. Grafting one of several monomers to one or both surfaces of fluorocarbons through radiation has been used to improve bondability and dyeability of fluorocarbons [86]. Radiation Applications, Inc., who developed the process, feel that we may soon be able to dissipate static electricity by radiation grafting [87].

Polyamides. A new ultrahigh melt viscosity nylon has been developed for extrusion of large shapes [88].

Phenolics. Although phenolics were among the first plastics, this resin continues to advance. Sisal-filled phenolics may be used when high strength is required. Phenolic-glass compounds are noteworthy for their lack of mold shrinkage. Melamine-modified phenolics show excellent arc resistance and are available in many light colors. Asbestos-filled phenolics have proved their worth in nose cones of space-age missiles [89].

Silicone Alloys. These alloys, formulated with a wide variety of resins such as methyl styrene and polyether, are used for products where uniformity of dielectric properties is essential; e.g., end-seal insulators of communications antenna for Navy submarines, or radomes for microwave antenna on submarines [90, 91].

Phosphonitriles. This series of inorganic polymers has several properties of interest to the plastics industry, such as resistance to high temperature, and chemical inertness. They should find use in brake linings and as binding agent in abrasive wheels [92].

Static-Free Materials. Suggested remedies for the static problem of plastics are a condensation product of an amino triazine, a keto compound and a polyalkylene oxide [93], a hydroxyethylated polyvinyl alcohol [94], and various surface treatments and additives [95].

Reinforced Plastics. Polyester moldings made by the premix technique offer fast, low-cost production of complex parts with the elimination of many assembly and finishing operations. Their good electrical insulation, chemical and heat resistance, low water absorption, and ability to hold close tolerance make them useful in various housings, centrifugal pumps, and circuit breaker bases [96].

Although formulated polyesters have limited shelf life of 3 to 6 months, they do relieve a molder of compounding worries. Moreover, it is possible to obtain a specific set of properties with some uniformity [97]. Epoxy-glass molding compounds provide high strength, structural efficiency, and economical production [98]. They have been used for pattern making [99]. Advantages of isophthalic acid polyester resins for glass-reinforced laminates are outlined [100]. They are useful at elevated temperatures and, with proper formulation, approach the epoxies in resistance to creep under wet conditions [101]. C-oil, an 80/20 butadiene/styrene resin polymerized mainly in the 1, 2-position, produces lightweight reinforced materials with good optical clarity and excellent electrical properties [102]. Glass yarn with aircraft grade prefinishes specifically designed for the resin to be used makes possible the use of 70 per cent by weight of glass reinforcement in high-strength molding materials [103]. Modulus of elasticity, tensile, elongation at rupture, and Poisson number have been computed for the glass-polyester system [104]. Terylene polyester fiber has been used for reinforcement [105]. Metal fibers have been used in applications for the tooling industry [106] and with rigid polyvinyl chloride to give greater rigidity and resistance to impact [107]. Sisal [108, 109] and jute [110] have been used in plastics, too.

A new material, "Orkot," used in bearings has given startling results—lower friction, higher strength-to-weight ratio, greater resistance to wear, and shorter "running in" time [111]. Water lubrication is possible because of the excellent wettability of Orkot. Kiln-dried wood can be protected by a complete covering of reinforced plastics [112]. Design and production of molded fiber-glass truck bodies were discussed in three papers at a meeting of the Society of Automotive Engineers [113, 114, 115], as were results of extensive service tests of highway tank trucks [116]. In developing reinforced plastics for gas-turbine usage, it has been pointed out that reinforcing filaments must be arranged in a specific pattern to carry calculated stresses [117].

As for processing techniques, lower cost and better quality control may be realized by spray-up systems where chopped or continuous strands of glass rovings are projected simultaneously or alternately with resin onto mold surfaces [118]. Equipment has been designed to preform glass-fiber rovings continuously without chopping [119]. Warpage has been corrected by design changes in molds rather than by the use of shrink rules [120]. New bonding techniques and new tool designs of a bladder molding process make possible the molding of shapes formerly considered impractical [121].

Some of the properties of reinforced plastics featured in various articles are the resin-glass bond characteristics [122, 123], effects of molding pressure [124] and of heat [125], durability [126], and surface erosion [127], tensile, compressive properties [128], and shear effects [129].

Engineering Properties

Testing. A survey of literature on analysis and testing of plastics has appeared [130]. Convenient methods of pinpointing a material are offered [131], simple tearing, burning, and smell tests for identifying basic types of plastic film [132], and a spot test for differentiating polyester from polyether-based urethanes [133]. A series of photographs give visual standards for inspection of reinforced plastics parts [134]. A method for evaluating degree of dispersion of carbon black in polyethylene film is based on the use of a photovolt transmission densitometer [135].

Some recent advances in the study of fracturing have appeared in an article concerning underlying principles of plastics testing [136]. Measurements at elevated temperatures are concerned in a simple elastomer for recording elastic moduli of plastics [137]; a thermal incline for measuring viscosity [138]; and a discussion of dimensional stability which explains why a test which is effective for thermosets has failed for thermoplastics [139]. A new apparatus and subsidiary equipment test low-temperature brittleness of polyethylene [140]. Equations were derived for determining rheological properties of films and coatings using the torsional oscillation method [141]. A self-contained ultrasonic unit with an oscilloscope seems to be more effective than fluoroscopy for detecting internal voids and flaws in plastics. Sensitivity of the test compares with that of x-ray techniques [142]. High-speed testing is taken into account in two articles [143, 144]. New findings support the theory that instrument readings, properly interpreted, are more accurate than bag drop or falling-ball

PLASTICS DEVELOPMENTS

tests for tensile impact tests on film [145]. A comparison is given of values obtained in Izod, Charpy tests on notched bars, and falling weight tests on disks of sheet material [146]. Ten-year creep data on four plastics laminates have formed the basis of long-time creep predictions [147]. A new test method has been proposed, and flexural, tensile, and shear-strength data given for epoxy and polyester for glass roving-reinforced plastics [148]. Integrally bonded foil resistance strain gages have been used to obtain interior distortion measurements in fiberglas-reinforced laminates [128]. A new method for studying internal stresses in casting resins provides design data for electronic embedments [149].

Properties. Properties of plastics have been tabulated in convenient reference form as surveys or guides to material selection [150-154]. Notched Izod values for some sixty materials are presented [155], and electrical properties of thirteen plastics [156] and twelve thermosetting laminates [157]. A chart relates ease of punching of various laminates to their mechanical and electrical properties [158]. Comparative data are given on polyurethane foam and some structural laminates under shock loading [159].

An extensive article on cellular polymers includes many photomicrographs and graphs [160]. Another emphasizes rigid foams, particularly thermal conductivity, resistance to heat, water vapor permeability, water absorption and mechanical properties [161]. A nomograph for determining water-vapor permeability of foams has been devised [162].

Temperature Effects. This age of astronautics has intensified the search for materials that will withstand extremes of temperature encountered in space flight [163, 164, 165]. Dynamic mechanical properties of polymers at low temperatures have been studied [166]. Tensile strength of plastic foams in cryogenic applications seems to be dependent on dimensions and orientation of the built-in notches formed by the cell walls [167]. Work in progress at the National Bureau of Standards will evaluate fluorocarbon polymers for high-temperature and radiation-resistant materials [168]. Chlorinated polyethers offer promise for moderately high temperatures up to 250 F [169].

Diepoxides cured with anhydrides have enhanced high-temperature properties [25]. Heat resistance increases as the functionality of the anhydride increases, giving service temperatures from 220 to 260 C with various diepoxides. Boron-phosphorus compounds are being studied at Wright Field in an effort to produce plastics stable up to 750 F [170]. Polymers stable at 1000 F may be based on aluminum-oxygen backbone or boron-silicone copolymers with nitrogen. Other materials of potential use are phosphino-borine compounds, liquid siloxyanyferrocenes, or compounds with boron-nitrogen or boron-boron bonds. Conclusion of a three-day meeting in Dayton was that no one material holds out exceptional promise for high-temperature applications [171].

Haveg Industries has developed a plastic which can stand up to 14,000 F for a short time before it begins to disintegrate [172]. One article summarizes information known about reinforced plastics from 3000 to 25,000 F [173]. The behavior of phenolic laminates up to 3000 F has been described [174]. In another study, reference is made to erosion rates of phenolic laminates reinforced with glass, high-silica glass, and nylon [175]. Although relative ratings vary considerably over the range of temperatures used (2000 to 7000 C), the nylon laminate showed the slowest erosion at 7000 C. Phenolic laminates with nylon cloth and with glass cloth were studied at temperatures up to 23,400 F. Compositions with high organic content performed best at high temperatures, while materials with high inorganic content were superior below 6000 F [176].

Radiation Effects. A number of plastics were rated according to intensity of damaging effects of radiation [177]. The effect of fillers and additives on mechanical properties must not be overlooked. This aspect is discussed in several articles [178, 179, 180]. Dynamic properties and solubility of irradiated polyethylene have been treated [181, 182, 183].

Health Hazards. Underlying principles and procedures for evaluating plastics which will be in contact with food are reviewed [184]. A committee of the British Plastics Federation has submitted a report including a table of toxicities where plastics were tested against a minimum of five extractants [185]. Trouble is still being experienced with dermatitis from amine curing agents for epoxy resins [186, 187, 188], but at least one solution has been worked out [189].

The rapidly growing use of thin-gage polyethylene for dry-cleaners' bags has unfortunately been accompanied by a number of cases of suffocation, mainly of children under one, where the film was being used for crib covers or where children were playing with the bags over their heads. One dry cleaner actually printed a soldier's uniform and face on the bags, indicating places to cut out arm holes so children could "play soldier" [190]. A wave of public alarm caused some dry cleaners to discontinue polyethylene garment bags. The Society of Plastics Industry on June 17, 1959, launched an educational program. Over two million copies of their booklet, "Helpful Hints to Parents on the Correct Use and Misuse of Plastics Film" have been distributed and placards distributed to dry-cleaning establishments [191]. Du Pont and Spencer Chemical Company have worked out methods of perforating polyethylene films to lessen the dangers of infant suffocation and have offered the process free of charge to film producers and converters [192].

Processing

The Society of Plastics Engineers has sponsored a book on processing of plastics [193]. General trends in recent machine design have been summarized [194] and recent developments in fabricating semifinished rigid polyethylene materials, including tool design [195]. A recent article summarizes molding and extrusion equipment and methods introduced in 1958 and early 1959 which are now considered available on a regular commercial basis [196]. Various processes have been subjected to automation including metering and mixing of epoxy resins [197], potting electrical components with epoxy resins [198], sheet forming of refrigerator door

liners [199], polyester premixing [200], and compression molding of powder or pellets [201]. Injection-molding profits from automation [202]. Automatic molding of thermosets requires materials that are easily preheated, feed uniformly, and cure rapidly [203].

Improvements continue to be made in kneaders and internal mixers [204, 205, 206]. It is shown that intensive mixing depends primarily on the degree of shear existing in the system [207].

Molding. Some general advice is given to engineers planning to buy compression or transfer presses [208] or auxiliary equipment for injection molding [209]. Economies may be realized by standardizing mold-base designs to accept interchangeable parts [210]. Realistic evaluation of molding cycle drive requirements may make possible savings in power requirements and hence in motor cost [211]. Proper mold-filling rates and techniques can be of great importance in dimensional tolerances and surface finish of molded parts [212]. Precompressed molding by means of valve gating has made possible greatly accelerated mold-filling rates [213]. A sixfold increase has been achieved with fast-acting precisely timed valves in multiple nozzles [214]. High-speed injection machines of the horizontal variety are available [215]. Various factors affecting transfer molding of dough compounds are reviewed [216], and constructional problems relating to hot-runner molds for making screw joints [217]. A formula has been worked out for calculating optimum number of cavities for molding [218]. Physical properties of premix moldings are affected by methods of molding [219]. Various problems have been solved in working with these materials; e.g., poor distribution of glass fibers, internal voids, cracks, sticking in the mold, warping, thin-wall problems [220]. The new polyolefins present new difficulties which have been met in various ways [221–225]. A quantitative report has been presented on how processing and material-selection factors in extrusion/blow molding influence wall thickness, crystallinity, permeability, and minimum cooling time of polyethylene bottles [226]. Molding problems also have been solved for diallyl phthalate compounds [227] and for rigid PVC [228]. A novel approach to molding problems has been solved by analyzing defects in injection moldings and tracing them back to the processing [229]. As a result, a vented reverse-flow heating cylinder has been developed which solves problems of strains, flaws, entrapped gas, vertical flow marks, and laminar drag marks.

Extrusion. Pointers have been offered on buying extrusion machines [230]. Extruder design has passed from an art to a science [231], which has been supported with basic studies [232, 233, 234]. Simplified equations have been worked out for quantitative descriptions of transverse flow in extruders [235]. Output can be raised significantly by designing a screw in consideration of the rheological properties of the specific plastic to be handled [197]. The significance of extrusion is stressed in a series of papers which assess the current situation, go into the engineering background of extrusion, into aspects of extrusion die design and machines available in nine countries showing specifications and photographs. New designs incorporate very high LD ratios, built-in and adjustable restrictor systems, and high-speed operations [236, 237]. Controlled pressure at the valve plus faster screw speed gives the same output with better quality due to improved thermal and mechanical homogeneity [238]. Power and heat theory for extrusion of PVC have recently been evaluated [239]. A practical compromise has been suggested between neck-in and draw-down for extrusion coating and film casting of polyethylene [240].

Vacuum Forming. This is fast achieving the high technical level of more established branches of the plastics industry [241]. Epoxy-resin molds have proved of great value in this field because they do not shrink, approach metals in stability, and give well-finished surfaces [242]. Basic principles have been discussed in one article which includes a diagram showing degree of deformation in relation to temperature. This is suggested as a means of determining suitability of a thermoplastic material for deep-drawing [243]. Economic factors have been discussed, pointing out the possibility of rapid, low-cost tooling which puts a vacuum-forming operation into production months before a similar molding job would be possible [244]. Special problems in this field related to high density polyethylene [245] and to toughened polystyrene are mentioned [246].

Bonding and Welding. Owens-Corning Fiberglas have sponsored a new book on bonding of reinforced plastics [247]. A study was made of adhesives and pretreatments for Cymac 325, Delrin, diallyl phthalate, Lexan, Marlex 50, Grex polyolefine, Moplen, Multrathane, and Penton [248]. Polyethylene can be rendered "adhesionable" by removing low-molecular components [249] or by oxidation [250]. Partially hydrogenated polybutadiene has produced good bonds between polyethylene and rubber, brass, or brass-plated metals [251]. A method has been worked out for bonding magnesium to polystyrene foam [252]. Adhesion techniques are used sometimes with rigid PVC pipe fittings when welding is not suitable [253]. A guillotine-edge electrode has been used to produce satisfactory welded seams in PVC sheeting [254]. Methods for welding the new vinyl-steel laminates have been mentioned previously [40]. Some mechanical means of fastening plastics are also described [255, 256].

Handling Cellular Products. Controlled conditions of heat and pressure in the initial operations will make possible production of any size and shape of expanded polystyrene [257]. Both high-density and low-density cellular vinyls have been produced by extrusion methods using conventional equipment [258, 259]. A process for making PVC-foam by the use of gas at high pressures may overcome many of the obstacles in methods based on thermal decomposition of gas-releasing additives [260]. A major growth impetus for polyether-based foams is seen in the one-shot process [261]. Isocyanate, catalyst, and polyols are mixed as they flow to the mold, whereas formerly prepolymers were made in one step and later combined with catalysts in a sensitive operation.

Other Developments. Curing cycles for phenolics can be reduced by as much as $^2/_3$ through electronic preheating and high-speed presses [262]. Fibrous mats, with or without fillers or resins, have been produced economically by a continuous process which gives much more uniform cores for high-pressure decorative lami-

nates [263]. Theoretical bases are offered for drying operations, especially in materials such as polyamides and cellulose acetate where moisture is held partly by polar groups and partly by capillary condensation [264]. One manufacturer has reported saving $5000 to $10,000 annually by ultrasonic methods of cleaning rouge-wax polishing compound from molded parts [265]. The number of rejects in a flash-removing operation has been reduced by using a converted drum polishing machine in which the moldings are clamped [266].

Plastics membranes with very small pores are produced by dissolving two or more polymers in a common solvent, spreading the solution, and allowing the solvent to evaporate. One of the polymers is then extracted from the resulting film with a selective solvent [267]. Theoretical determination of the length of water bath for cooling extruded PVC cable may be useful as size of extruded articles and speed of processing both increase [268]. A handy reference guide has been provided covering the marking of plastics in sheet, rod, tube, molded, or fabricated forms [269]. A wet-belt grinding technique has been worked out for control of finish flatness and interfacial angles of acrylic castings [270]. Vinyl scrap can be ground and rid of contaminants at a cost of six cents per pound by a low-temperature grinding process [271]. A new coating method involves heating of an object and dipping it into a fluidized, air-agitated bed of fine polymer particles [272].

Products

A series of articles give case histories where products have been improved at the same or lower cost with plastics [273]. This includes a 10-year graph (1948–1958) showing cost per cu in. of various plastic materials and for three metals used in the same type of application. One of the largest known applications of vinyl plastics has been protection of all submerged and semisubmerged steel structures in the Canadian section of the St. Lawrence Seaway with a vinyl-chloride vinyl-acetate solvent-based paint [274]. An interesting plastic smoke has been developed by injecting formulations of foam-forming plastics into a stream of hot gas at temperatures higher than those needed for foam development. Plastic droplets are expanded to a cellular form with an extremely low fall-out rate. These materials, called "floke," have great potential as tracers for rockets and missiles, in seeding rain clouds, preventing evaporation losses from reservoirs, and protecting crops [275]. A bibliography with abstracts on plastic tooling has appeared under the sponsorship of the American Society of Tool Engineers [276]. Stereo groove structure and needle size in new hi-fi records necessitate use of materials with low viscosity at molding temperatures to minimize cycle time and yet reproduce accurately 350 grooves per in. [277]. An alloyed plastic of undisclosed composition has been developed over the past few years to furnish a completely new oilless bearing material with high load capacity and low coefficient of friction [278]. Plastic piston rings have been designed for nonlubricated applications [279].

Insulation. Improved laminates, precured tapes, and high-temperature materials have added new dimensions to insulation [280, 281]. Plastics foams have a very large potential for many insulation applications [282]. Tables of comparative material costs and significant properties of these foams are presented. Acrylic-resin insulations have been used for magnet wire and rag-paper space insulation where older enamels, polyesters, and polyurethanes were inadequate [283]. Future materials needed for ocean telephone cables should be more abrasion and cut-resistant than jute. The newer high-density polyethylenes may fill the requirement, although stress-cracking and water-aggravated embrittlement have been problems in the early stages of this development. Internally plasticized, semirigid typesof polyvinyl chloride because of their low water extractability may also be useful [284].

Building. Monsanto has estimated that 709 million lb of plastic materials were used in construction during 1958 [285]. Rigid foams, because of their cost and properties, have a firm competitive position in future markets [286]. One particular material, a studless styrene foam core panel, greatly reduces on-site labor costs and even exceeds FHA specifications [287]. A German book on the subject of plastics in building is liberally illustrated with photographs, color plates, and line drawings and includes tables of materials [288].

Automotive Industries. It has been estimated that 20 lb of plastics were used in the average 1958 car. A chart shows the location of approximately 220 plastic parts in an automobile [289]. Some problems in applying plastics to motor vehicles and their solutions have been discussed [290].

Packaging. Properties and likely applications are given for films commercially processed from medium and high-density polyethylene, polypropylene, and nylon 6 [291–295]. Materials packed in polyethylene film can be sterilized with ethylene oxide satisfactorily [296]. A specially designed heat-sealing device for shopkeepers enables them to seal packages in polyethylene film within 0.5 to 2 sec [297]. Oriented and unoriented polyester film behave as two entirely different materials [298]. The oriented variety is easily heat-sealable and bonded on one or both sides [299]. Curves have been drawn for predicting service life of Mylar-type polyester film at various temperatures and humidities [300].

Mechanical research at Battelle Memorial Institute has shown that soft plastic film can be handled in packaging machines at high web speeds [301].

Pipe. Sales of plastic pipe in 1958 totaled more than $50 million [302] and are expected to reach $70 million and 5 million linear ft by 1960, climbing to $200 million by 1966 [303, 304]. A major break for plastic-pipe makers occurs whenever state or city laws are formulated to permit use of plastic pipe in water service lines. This was the case recently in California. However, their brands must be approved either by the Western Plumbing Association or by the American Water Works Association [305]. In Maine, approval has been given plastic pipe for cold-water service, subject to standards of the National Sanitation Foundation [302]. Approval of plastic for transport of other fluids also gives a boost, as, for example, the use in cities in Holland for gaseous fuels [306], applications with crude oil [307], and with

hydrogen sulfide [308]. Predictions have been made by W. Kinsolving of Sun Pipe Line Company of machines that will dig a trench and extrude plastic pipe at the same time [309]. Technical data on various materials for piping are found frequently today. Operating data for reinforced epoxy piping are tabulated in one article [310]. Extrusion conditions for polyethylene pipe have been discussed [311, 312]. Properties of polypropylene [313] and nylon 6 [314] pipe have been mentioned. High-impact PVC pipe has been studied extensively both as to properties and characteristics, market needs and potential, and processing and design considerations [315]. Creep and stress-rupture behavior of rigid PVC pipe were the subject of another study [316].

A good deal of attention has been paid to extrapolating short-term values to predict permissible stresses on plastic pipe over a period of years [317, 318, 319, 320, 321]. Simplified calculations of load loss have been devised for evaluating hydraulic performance of PVC pipes [322]. Several nomographs have been proposed for determining cross section of plastic pipe [323].

The Future

A. F. Sward of Union Carbide predicts that by 1965 production of plastics will be reckoned in millions of lb somewhat according to this pattern [324]:

Polyethylene	2150
Vinyls	1400
Polystyrene	860
Coumarone indene	350
Phenolics	600
Urea-melamine	440

Rigid PVC alone is expected to account for 70 million lb per year by the mid-1960's [325]. Du Pont has released figures for anticipated use of plastics in automobiles within five years [326]. In spite of present overcapacity in the polyurethane field, at least two of the leaders in the industry are launching big expansion programs [327]. Japan will doubtless become a vigorous competitor in many export markets, one example cited being Japanese PVC being offered c.i.f. Rotterdam for 17¢ per lb [328, 329].

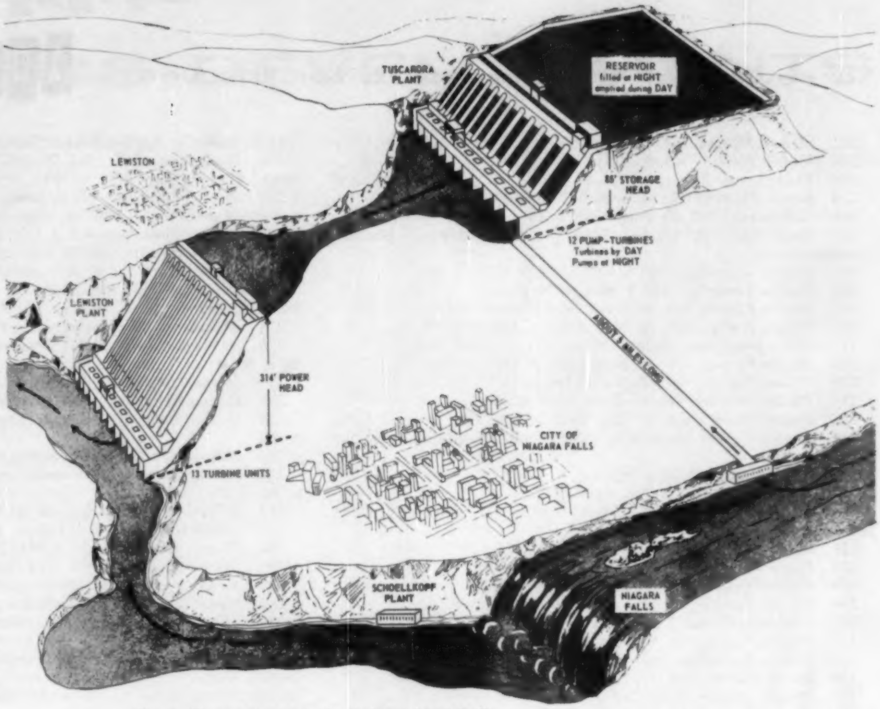
References

1 MECHANICAL ENGINEERING, vol. 81, March, 1959, p. 54.
2 *Modern Plastics*, vol. 36, Jan. 1959, p. 135.
3 *Modern Plastics*, vol. 36, Jan. 1959, p. 112.
4 *Modern Plastics*, vol. 36, Jan. 1959, p. 71.
5 *Materials in Design Engineering*, vol. 49, April, 1959, p. 105.
6 *German Plastics Digest*, Munich, vol. 48, January, 1958.
7 *Applied Plastics*, London, vol. 1, Jan. 1958.
8 *Journal of Applied Polymer Science*, New York, Interscience. vol. 1, Jan.-Feb., 1959.
9 *Advances in Polymer Science (Fortschritte der Hochpolymeren-Forschung)*, Berlin, vol. 1, 1958.
10 *Adhesive Age*, vol. 1, October, 1958.
11 H. R. Simonds, "Source Book of the New Plastics," New York, Reinhold, 1959.
12 *Materials in Design Engineering*, vol. 49, Feb. 1959, p. 103.
13 *Modern Plastics*, vol. 36, Dec. 1958, p. 103.
14 *Applied Plastics*, vol. 1, July, 1958, p. 21.
15 Society of Plastics Engineers, Technical Papers 5, Jan. 1959, p. 74-1.
16 *Journal of Applied Polymer Science*, vol. 1, March-April, 1959, p. 158.
17 *Wall Street Journal*, vol. 39, July 14, 1959, p. 1.
18 *SAE Transactions*, vol. 67, 1959, p. 265.
19 MECHANICAL ENGINEERING, vol. 81, April, 1959, p. 60.
20 *Western Plastics*, vol. 6, April, 1959, p. 17.
21 *Journal of Applied Polymer Science*, vol. 1, March-April, 1959, p. 179.
22 *Journal of Applied Polymer Science*, vol. 1, March-April, 1959, p. 169.
23 *Journal of Applied Polymer Science*, vol. 1, March-April, 1959, p. 185.
24 *Product Engineering*, vol. 29, Sept. 29, 1958, p. 36.
25 *SPE Journal*, vol. 15, April, 1959, p. 289.
26 *Journal of Chemical and Engineering Data*, vol. 4, Jan. 1959, p. 79.
27 *Plastics Industry*, vol. 16, Dec. 1958, p. 38.
28 *Plastics Technology*, vol. 4, Aug. 1958, p. 726.
29 *Machine Design*, vol. 30, June 12, 1958, p. 127.
30 *Modern Plastics*, vol. 36, Nov. 1958, p. 156.
31 *Kunststoffe*, vol. 49, Feb. 1959, p. 50. In German, condensed English version.
32 *Chimica Industria*, vol. 40, May, 1958, p. 356. In Italian.
33 *Plastics*, vol. 23, Dec. 1958, p. 433.
34 *Kunststoffe*, vol. 48, Nov. 1958, p. 549. In German, condensed English version.
35 *Materials in Design Engineering*, vol. 48, Oct. 1958, p. 98.
36 *Oil, Paint, Drug Reporter*, vol. 176, July 27, 1959, pp. 4, 56.
37 *Plastics*, vol. 24, Feb. 1959, p. 57.
38 *Rubber and Plastics Age*, vol. 40, June 1959, p. 654.
39 *Metal Products Manufacturing*, vol. 16, April, 1959, p. 75. *Battelle Technical Review*, vol. 8, June, 1959, p. 317a.
40 *Metalworking Prod.*, vol. 102, 1959, p. 2079. *Rubber Abstracts*, vol. 37, April, 1959, p. 174.
41 *Plastics World*, vol. 17, Aug. 1959, p. 6.
42 *Chemical and Engineering News*, vol. 37, April 6, 1959, p. 38.
43 *Plastics*, vol. 24, April, 1959, p. 127.
44 *Plastics Technology*, vol. 5, June, 1959, p. 31.
45 *Insulation Review*, vol. 2, no. 6, 1958, pp. 18, 41. *Rubber Abstracts*, vol. 37, Feb. 1959, p. 80.
46 *Insulation Review*, vol. 2, no. 8, 1958, p. 30. *Rubber Abstracts*, vol. 37, March, 1959, p. 130.
47 *Product Engineering*, vol. 29, Nov. 10, 1958, p. 86.
48 *Journal of the American Oil Chemists' Society*, vol. 36, Jan. 1959, p. 16.
49 *Rubber World*, vol. 138, June, 1958, p. 417.
50 *Rubber World*, vol. 139, Feb. 1959, p. 685.
51 *Adhesives Age*, vol. 2, April, 1959, p. 29.
52 *Plastics Industry*, vol. 16, Nov. 1958, p. 34.
53 *Modern Plastics*, vol. 36, Dec. 1958, p. 96.
54 *Kunststoffe*, vol. 49, Jan. 1959, p. 3. Feb. 1959, p. 93. In German.
55 *Modern Plastics*, vol. 36, April, 1959, p. 115.
56 *Plastics Institute Transactions and Journal*, vol. 27, April, 1959, p. 55.
57 *Materie Plastiche*, vol. 25, April, 1959, p. 277. In Italian.
58 *Materie Plastiche*, vol. 25, March, 1959, p. 181. In Italian.
59 *Journal of Polymer Science*, vol. 35, Feb. 1959, p. 285.
60 *Kunststoffe*, vol. 49, March, 1959, p. 102. In German, condensed English version.
61 *Applied Plastics*, vol. 2, April, 1959, p. 16.
62 *SPE Journal*, vol. 15, May, 1959, p. 368.
63 *Industrial and Engineering Chemistry*, vol. 50, July, 1958, p. 1045.
64 *SPE Journal*, vol. 15, May, 1959, p. 397.
65 *Journal of Polymer Science*, vol. 33, Dec. 1958, p. 505.
66 *Plastics Technology*, vol. 5, Feb. 1959, p. 35.
67 *Modern Plastics*, vol. 36, March, 1959, p. 146.
68 *Journal of Physical Chemistry*, vol. 62, Dec. 1958, p. 1530.
69 *Plastics Technology*, vol. 5, May, 1959, p. 35.
70 *Plastics*, vol. 24, Jan. 1959, p. 31.
71 *Journal of Applied Polymer Science*, vol. 1, Jan.-Feb., 1959, p. 37.
72 *Journal of Applied Polymer Science*, vol. 1, Jan.-Feb., 1959, p. 43.
73 *Product Engineering*, vol. 30, March 16, 1959, p. 55.
74 *Industrie Plastiques Modernes*, vol. 11, Jan. 1959, p. 37. In French. *SPE Journal*, vol. 14, June, 1958, p. 35.
75 *Kunststoffe*, vol. 48, June, 1958, p. 242. In German.
76 *Kunststoffe*, vol. 48, Oct. 1958, p. 494. In German, condensed English version.
77 *Chemistry and Industry*, vol. 34, Aug. 23, 1958, p. 1111.

PLASTICS DEVELOPMENTS

78 *Wire and Wire Products*, vol. 33, June, 1958, p. 649; *Battelle Technical Review*, vol. 7, Sept. 1958, p. 637a.
79 *Plastics*, vol. 23, Aug. 1958, p. 282.
80 *Journal of Chemical and Engineering Data*, vol. 4, Jan. 1959, p. 57.
81 *Kunststoffe*, vol. 49, May, 1959, p. 209. In German, condensed English version.
82 *Plastics Technology*, vol. 4, July, 1958, p. 644.
83 *Materials in Design Engineering*, vol. 48, Oct. 1958, p. 106.
84 *Plastis Week*, vol. 18, no. 10, March 10, 1958, p. 1.
85 *Materials in Design Engineering*, vol. 49, May, 1959, p. 143.
86 *Chemical and Engineering News*, vol. 37, no. 5, Feb. 2, 1959, p. 44.
87 *Plastics Industry*, vol. 17, April, 1959, p. 35.
88 *Rubber and Plastics Age*, vol. 39, Aug. 1958, p. 673.
89 *Plastics Technology*, vol. 5, Feb. 1959, p. 49.
90 *Western Plastics*, vol. 6, March, 1959, p. 38.
91 *SPE Journal*, vol. 14, Dec. 1958, p. 35.
92 *British Plastics*, vol. 31, Nov. 1958, p. 473.
93 Static free plastic. Australian Patent 40,830. Bohme Fettchemie.
94 Static resistant hydrophobic resin composition, Andrew T. Walter (Assignor to Union Carbide Co.), U. S. Patent 2,874,023, Feb. 17, 1959.
95 *Chemical Week*, vol. 84, May 23, 1959, p. 53.
96 Society of the Plastics Industry, Reinforced Plastics Division, 14th Annual Technical and Management Conference, Feb. 3–5, 1959: summarized in *Materials in Design Engineering*, vol. 50, July, 1959, p. 10.
97 *Plastics*, vol. 24, May, 1959, p. 172.
98 *Materials in Design Engineering*, vol. 47, May, 1958, p. 106.
99 *British Plastics*, vol. 32, May, 1959, p. 186.
100 *Modern Plastics*, vol. 36, June, 1959, p. 135.
101 Society of the Plastics Industry, Reinforced Plastics Division, 14th Annual Technical and Management Conference, Feb. 3–5, 1959.
102 *British Plastics*, vol. 32, Feb. 1959, p. 69.
103 *Plastics Industry*, vol. 16, Oct. 1958, p. 32.
104 *VDI Zeitschrift*, vol. 101, April 21, 1958, p. 463; *Battelle Technical Review*, vol. 8, Aug., 1959, p. 484a.
105 *Rubber and Plastics Age*, vol. 40, May, 1959, p. 439.
106 *SPE Journal*, vol. 14, Sept. 1958, p. 31.
107 *Corrosion Technology*, vol. 5, 1958, p. 181; *Rubber Abstracts*, vol. 36, August, 1958, p. 372.
108 Irish Ropes, Ltd. Dec. 1958, 6 pp.
109 *Rubber Journal and International Plastics*, vol. 136, Feb. 7, 1959, p. 216.
110 *Industrie de Plastiques modernes*, 1959, vol. 11, no. 3, p. 33, no. 4, p. 35, no. 6, p. 49. In French.
111 *Canadian Metalworking*, Aug. 1958, p. 42, *European Technical Digest*, vol. 4, E.T.D. no. 2882, Feb. 1959.
112 *SPE Journal*, vol. 14, Sept. 1958, p. 40.
113 Society of Automotive Engineers, Oct. 1958, SAE 100 C. *SAE Journal*, vol. 67, Feb. 1959, p. 64.
114 Society of Automotive Engineers, SAE 100 A, Oct. 1958.
115 Society of Automotive Engineers, SAE 100 B, Oct. 1958.
116 *Corrosion*, vol. 15, Feb. 1959, p. 94.
117 *Canadian Plastics*, Nov. 1957, p. 60; *European Technical Digest*, vol. 3, E.T.D. no. 2460, July, 1958.
118 *Modern Plastics*, vol. 36, May, 1959, p. 85.
119 *Plastics Industry*, vol. 17, June, 1959, p. 35.
120 *Plastics Technology*, vol. 4, Nov. 1958, p. 1011.
121 *American Machinist*, vol. 102, April 7, 1958, p. 102, *Modern Plastics*, vol. 35, July, 1958, p. 132.
122 *ASTM Bulletin*, no. 235, Jan. 1959, p. 63.
123 *Industrial and Engineering Chemistry*, vol. 50, June, 1958, p. 912.
124 *SPE Journal*, vol. 14, June, 1958, p. 40.
125 *British Plastics*, vol. 31, Oct. 1958, p. 432.
126 *Plastics Technology*, vol. 5, June 1959, p. 42.
127 *Modern Plastics*, vol. 36, Dec. 1958, p. 135.
128 *ASTM Bulletin*, no. 233, Oct. 1958, p. 40.
129 *ASTM Bulletin*, no. 238, May, 1959 p. 38.
130 *Kunststoff-Rundschau*, vol. 5, Nov. 1958, p. 473, Dec. 1958, p. 520. In German.
131 *Western Plastics*, vol. 6, Jan. 1959, p. 16.
132 *Modern Packaging*, vol. 32, Oct. 1958, p. 135.
133 *Rubber Digest*, vol. 9, Jan. 30, 1959, p. 5.
134 *Materials in Design Engineering*, vol. 49, March, 1959, p. 106.
135 *Modern Plastics*, vol. 35, Aug. 1958, p. 125.
136 *Schweizer Archiv*, vol. 25, Feb. 1959, p. 40. In German.
137 *ASTM Bulletin*, no. 231, July, 1958, p. 65.
138 *Transactions of the Society of Rheology*, vol. 1, 1957, p. 191.
139 *Kunststoffe*, vol. 49, May, 1959, p. 228. In German, condensed English version.
140 *ASTM Bulletin*, no. 231, July, 1958, p. 68.
141 *Kolloid Zeitschrift*, vol. 160, Sept. 1958, p. 44. In English.
142 *Chemical and Engineering News*, vol. 37, June 22, 1959, p. 39.
143 *SPE Journal*, vol. 14, Dec. 1958, p. 31.
144 *Chemical Week*, vol. 83, Dec. 27, 1959, p. 76.
145 *Modern Packaging*, vol. 32, Sept. 1958, p. 147.
146 *British Plastics*, vol. 32, April, 1959, p. 156.
147 *ASTM Proceedings*, vol. 58, 1958, p. 841.
148 *Plastics Technology*, vol. 4, Nov. 1958, p. 1017.
149 *SPE Journal*, vol. 14, Aug. 1958, p. 33.
150 *Western Plastics*, vol. 6, March, 1959, p. 24.
151 *Materials in Design Engineering*, vol. 48, mid-Oct., 1958, p. 7.
152 *Materials in Design Engineering*, vol. 47, June, 1958, p. 113.
153 *Applied Plastics*, vol. 1, May, 1958, p. 30.
154 *Product Engineering*, Design Digest Issue, vol. 29, mid-Sept., 1958, p. C11.
155 *Materials in Design Engineering*, vol. 49, March, 1959, p. 131.
156 *Applied Plastics*, vol. 2, March, 1959, p. 14.
157 *ASTM Bulletin* no. 238, May, 1959, p. 33.
158 *Product Engineering*, vol. 30, Feb. 2, 1959, p. 57.
159 *SPE Journal*, vol. 15, Jan. 1959, p. 43.
160 *Plastics Institute Transactions and Journal*, vol. 26, July, 1958, p. 299.
161 *Plastics Institute Transactions and Journal*, vol. 26, July, 1958, p. 208.
162 *Chemical Processing*, vol. 22, Jan. 1959, p. 53.
163 *Applied Plastics*, vol. 1, June, 1958, p. 21.
164 *SPE Journal*, vol. 15, March, 1959, p. 211.
165 *Plastics Institute Transactions and Journal*, vol. 25, July, 1957, p. 231.
166 *Advances in Polymer Science*, vol. 1, 1958, p. 114.
167 *SPE Journal*, vol. 14, Nov. 1958, p. 36.
168 *NBS Technical News Bulletin*, vol. 43, April, 1959, p. 76.
169 *Chemical Engineering*, vol. 66, March 23, 1959, p. 194.
170 *Petrochemical Industries*, vol. 2, July, 1959, p. 7.
171 *Chemical and Engineering News*, vol. 37, June 15, 1959, p. 40.
172 *Wall Street Journal*, vol. 39, June 3, 1958, p. 16.
173 *Materials in Design Engineering*, vol. 47, June 1958, p. 100.
174 *Rubber and Plastics Age*, vol. 39, Nov. 1958, p. 961.
175 *British Plastics*, vol. 31, Dec. 1958, p. 530. *Chemical Engineering*, vol. 66, June 1, 1959, p. 134.
176 *Modern Plastics*, vol. 36, April, 1959, p. 137.
177 *Modern Plastics*, vol. 36, Nov. 1958, p. 199.
178 *Transactions IRI*, vol. 34, Aug. 1958, p. 175.
179 *Revue générall du caoutchouc*, vol. 36, March, 1959, p. 369. In French.
180 *Plastics*, vol. 24, Feb. 1959, p. 74.
181 *Journal of Applied Physics*, vol. 29, Oct. 1958, p. 1415.
182 *Proceedings of the Royal Society*, vol. 249A, Jan. 13, 1959, p. 367.
183 *Journal of Applied Polymer Science*, vol. 1, March-April, 1959, p. 129.
184 *Plastics Technology*, vol. 4, Sept. 1958, p. 812
185 *British Plastics*, vol. 31, March, 1958, p. 115.
186 Atomic Energy Research Establishment, Great Britain, MED/M27.
187 *Rubber Age*, vol. 84, Oct. 1958, p. 100.
188 *Plaste und Kautschuk*, vol. 5, Feb. 1958, p. 68. In German. Cf. *SPE Journal*, vol. 13, 1957, p. 25.
189 *American Industrial Hygiene Association Journal*, vol. 19, June, 1958, p. 258. *Battelle Technical Review*, vol. 7, Nov. 1958, p. 771a
190 *Consumer Reports*, vol. 24, Aug. 1959, p. 399.
191 *SPE Journal*, vol. 15, July, 1959, p. 533.
192 *Modern Plastics*, vol. 36, July, 1959, p. 93.
193 "Processing of thermoplastic materials," by E. C. Bernhardt, New York, Reinhold, 1959.
194 *Plastics Institute Transactions and Journal*, vol. 26, July, 1958, p. 251.
195 *Kunststoffe*, vol. 48, July, 1958, p. 345. In German, condensed English version.
196 *Western Plastics*, vol. 6, Aug. 1959, p. 17.
197 *Adhesives Age*, vol. 1, Oct. 1958, p. 28.
198 *Rubber and Plastic Age*, vol. 39, Aug. 1958, p. 677.
199 *Modern Plastics*, vol. 36, March, 1959, p. 102.
200 *Modern Plastics*, vol. 36, June, 1959, p. 128.
201 *Plastics*, vol. 24, May, 1959, p. 194.

202 *Western Plastics*, vol. 5, Oct. 1958, p. 31.
203 *Modern Plastics*, vol. 35, July, 1958, p 104.
204 *Plastics*, vol. 28, Sept. 1958, p. 340.
205 *British Plastics*, vol. 31, Sept. 1958, p. 404.
206 *SPE Journal*, vol. 14, Aug. 1958, p. 24.
207 *Kunststoffe*, vol. 49, Jan. 1959, p. 18. In German, condensed English version.
208 *Plastics Technology*, vol. 5, Feb. 1959, p. 53.
209 *Plastics Technology*, vol. 5, May, 1959, p. 43.
210 *Modern Plastics*, vol. 36, Nov. 1958, p. 181.
211 *Modern Plastics*, vol. 36, Nov. 1958, p. 194.
212 *SPE Journal*, vol. 15, Jan. 1959, p. 31.
213 *Modern Plastics*, vol. 36, Sept. 1958, p. 117.
214 *Modern Plastics*, vol. 36, Nov. 1958, p. 187.
215 *Plastics Industry*, vol. 17, May, 1959, p. 26.
216 *British Plastics*, vol. 31, Dec. 1958, p. 509.
217 *Kunststoffe*, vol. 49, March, 1959, p. 149. In German, condensed English version.
218 *SPE Journal*, vol. 14, July, 1958, p. 32.
219 *Plastics Technology*, vol. 5, April, 1959, p. 43.
220 *Modern Plastics*, vol. 36, March, 1959, p. 117, May, 1959, p. 115, July, 1959, p. 110.
221 *Modern Plastics*, vol. 36, Feb. 1959, p. 111.
222 *Plastics Technology*, vol. 3, June, 1958, p. 556.
223 *Plastics Technology*, vol. 3, June, 1958, p. 547.
224 *Plastics Technology*, vol. 3, June, 1958, p. 537.
225 *SPE Journal*, vol. 15, Feb. 1959, p. 142.
226 *Modern Plastics*, vol. 36, May, 1959, p. 107.
227 *Plastics Technology*, vol. 5, May, 1959, p. 38.
228 *British Plastics*, vol. 31, Nov. 1958, p. 468.
229 *Plastics Industry*, vol. 17, Feb. 1959, p. 16.
230 *Plastics Technology*, vol. 4, Sept. 1958, p. 817.
231 *Modern Plastics*, vol. 36, Dec. 1958, p. 115.
232 *Kunststoffe*, vol. 49, Jan., Feb., March, 1959, p. 15, 63, 121. In German, brief English version.
233 *British Plastics*, vol. 31, May, 1958, p. 201.
234 *SPE Journal*, vol. 15, May, 1959, p. 383.
235 *Industrial and Engineering Chemistry*, vol. 51, June, 1959, p. 765.
236 *British Plastics*, vol. 31, July, 1958, p. 267.
237 *SPE Journal*, vol. 14, June, 1958, p. 108.
238 *Rubber and Plastics Age*, vol. 39, Dec. 1958, p. 1075.
239 *SPE Journal*, vol. 15, April, 1959, p. 311.
240 *Plastics Technology*, vol. 4, Oct. 1958, p. 918.
241 *Plastics Industry*, vol. 16, Oct. 1958, p. 20.
242 *Plastics*, vol. 23, July, 1958, p. 248.
243 *Kunststoffe*, vol. 49, March, 1959, p. 152. In German, condensed English version.
244 *Product Engineering*, Design Digest Issue 29, mid-Sept. 1958, p. D4.
245 *British Plastics*, vol. 32, May 1959, p. 195.
246 *British Plastics*, vol. 31, Dec. 1958, p. 518.
247 "Adhesive bonding of reinforced plastics," H. A. Perry, New York, McGraw-Hill, 1959.
248 *Plastics Technology*, vol. 4, Aug. 1958, p. 721.
249 *Adhesives Age*, vol. 2, Feb. 1959, p. 23.
250 *Industrial and Engineering Chemistry*, vol. 50, June, 1958, p. 904.
251 *Rubber World*, vol. 138, June, 1958, p. 418.
252 *Adhesives Age*, vol. 1, Oct. 1958, p. 32.
253 *Plastiques Informations*, May 1, 1958, p. 7, and May 16, 1958, p. 5; *Plastics Technology*, vol. 5, April, 1959, p. 84.
254 *Kunststoffe*, vol. 48, Oct. 1958, p. 491. In German, condensed English version.
255 *Materials in Design Engineering*, vol. 48, Oct. 1958, p. 156.
256 *Product Engineering*, Design Digest Issue 29, mid-Sept. 1958, p. G2.
257 *Plastics Industry*, vol. 17, June, 1959, p. 34.
258 *Plastic Technology*, vol. 5, April, 1959, p. 32.
259 *Plastics Technology*, vol. 5, March, 1959, p. 27.
260 *Kunststoffe*, vol. 48, May, 1958, p. 194. In German.
261 *Chemical and Engineering News*, vol. 36, Dec. 1, 1958, p. 48.
262 *SPE Journal*, vol. 15, April, 1959, p. 293.
263 *Modern Plastics*, vol. 36, Sept. 1958, p. 115.
264 *Chimie et Industrie*, vol. 78, 1957, p. 494; *Journal of Applied Chemistry*, vol. 8, May, 1958, p. i-541.
265 *Plastics Technology*, vol. 4, Nov. 1958, p. 1013.
266 *Kunststoffe*, vol. 48, Oct. 1958, p. 489. In German, condensed English version.
267 *Journal of Applied Polymer Science*, vol. 1, Jan-Feb. 1959, p. 50.
268 *Nachrichtentech Z.*, vol. 11, no. 11, 1958, p. 557; *Rubber Abstracts*, vol. 37, May, 1959, p. 224.
269 *Plastics Technology*, vol. 5, June, 1959, p. 39.
270 *Modern Plastics*, vol. 36, May, 1959, p. 127.
271 *Plastics Technology*, vol. 4, Dec. 1958, p. 1122.
272 *Modern Plastics*, vol. 36, Oct. 1958, p. 125.
273 *Modern Plastics*, vol. 36, Nov. 1958, p. 129.
274 *Paint, Oil and Chemical Review*, vol. 122, Jan. 22, 1959, p. 12; *Plastics Industry*, vol. 17, June, 1959, p. 22.
275 *Chemical and Engineering News*, vol. 37, April 20, 1959, p. 66.
276 *American Society of Tool Engineers*, vol. 1, 1957, 46 pp., vol. 2, 1958, 60 pp.
277 *Chemical Engineering*, vol. 66, March 9, 1959, p. 80.
278 *Product Engineering*, vol. 30, May 25, 1959, p. 58.
279 *Product Engineering*, Design Digest Issue, 29, mid-Sept. 1958, p. F7.
280 *Materials in Design Engineering*, vol. 48, Nov. 1958, p. 108.
281 *Plastics Institute Transactions and Journal*, vol. 27, April 1959, p. 30.
282 *Rubber and Plastics Age*, vol. 40, March, 1959, p. 250.
283 *ASHRAE Journal*, vol. 1, June, 1959, p. 41.
284 *Plastics Technology*, vol. 5, May, 1959, p. 57.
285 *Plastics World*, vol. 17, Aug. 1959, p. 7.
286 *Modern Plastics*, vol. 36, Dec. 1958, p. 91.
287 *Modern Plastics*, vol. 36, March, 1959, p. 100.
288 "*Kunststoffe im Raum*," E. Jakubowski and F. Nitsch, Munich, Callwey, 1958.
289 *Automotive Industries*, vol. 119, July 1, 1958, p. 58. *SPE Journal*, vol. 14, Oct. 1958, p. 23.
290 *Plastics Institute Transactions and Journal*, vol. 26, Oct. 1958, p. 415.
291 *Plastics World*, vol. 17, April, 1959, p. 22.
292 *Modern Packaging*, vol. 32, April, 1959, p. 203.
293 *Modern Packaging*, vol, 32, Jan. 1959, p. 113.
294 *Modern Packaging*, vol. 32, Feb. 1959, p. 118.
295 *Package Engineering*, vol. 4, March, 1959, p. 62.
296 *Neue Verpackung*, vol. 11, 1958, p. 459. *Rubber Abstracts*, vol. 36, Nov. 1958, p. 512.
297 *Electro Radiomercuur*, vol. 27, Aug. 1958, p. 683; *European Technical Digest*, vol. 3 E.T.D. #2647, Oct. 1958.
298 *Package Engineering*, vol. 3, Nov. 1958, p. 27.
299 *Modern Packaging*, vol. 32, March, 1959, p. 111.
300 *Materials in Design Engineering*, vol. 49, Feb. 1959, p. 94.
301 *Modern Packaging*, vol. 32, April, 1959, p. 206.
302 *Chemical and Rubber Industry Report*, vol. 6, April, 1959, p. 14.
303 *Chemical Week*, vol. 83, Aug. 9, 1958, p. 77.
304 *Modern Plastics*, vol. 35, Aug. 1958, p. 96.
305 *Chemical Week*, vol. 85, July 25, 1959, p. 97.
306 *Plastica*, vol. 11, July, 1958, p. 522. In Dutch.
307 *Oil and Gas Journal*, vol. 56, Dec. 22, 1958, p. 38.
308 *Le Genie Civil*, no. 5, Sept. 1, 1958, p. 356. *European Technical Digest*, vol. 3, E.T.D. #2785, Dec. 1958.
309 *New York Times*, vol. 107, no. 37020, June 3, 1959, p. 49L, col. 1.
310 *Western Plastics*, vol. 5, July 15, 1958, p. 17.
311 *Plastics Technology*, vol. 4, Aug. 1958, p. 717.
312 *Plastics Technology*, vol. 4, Dec. 1958, p. 1107.
313 *Materie Plastiche*, vol. 24, Dec. 1958, p. 1109. In Italian.
314 *Chemical Engineering*, vol. 65, Dec. 1, 1958, p. 130.
315 *Plastics*, vol. 24, Jan. 1959, p. 24, Feb. 1959, p. 67, March, 1959, p. 98.
316 *Modern Plastics*, vol. 35, July, 1958, p. 120, Aug. 1958, p. 132.
317 *Kunststoffe*, vol. 49, March, 1959, p. 113. In German, condensed English version.
318 *Plastics*, vol. 24, April, 1959, p. 147; *Kunststoffe*, vol. 49, March, 1959, p. 109.
319 *Kunststoffe*, vol. 49, March, 1959, p. 116; *Plastics*, vol. 24, April, 1959, p. 153. *Rubber and Plastics Age*, vol. 39, May, 1958, p. 364.
320 *SPE Journal*, vol. 15, May, 1959, p. 418.
321 *Modern Plastics*, vol. 36, Oct. 1958, p. 144.
322 *European Technical Digest* 3, E.T.D. #2660, Oct. 1958
323 *Kunststoff-Rundschau*, vol. 5, Nov. 1958, p. 483. In German.
324 *Chemical and Engineering News*, vol. 37, June 1, 1959, p. 29.
325 *Modern Plastics*, vol. 36, Dec. 1958, p. 107.
326 *Chemical and Engineering News*, vol. 37, June 8, 1959, p. 21.
327 *Chemical Week*, vol. 84, April 4, 1959, p. 21.
328 *Plastica*, vol. 11, Dec. 1958, p. 923. In Dutch.
329 *Modern Plastics*, vol. 36, Sept. 1958, p. 109.



At night, Tuscarora will be a pumping station, driving Niagara's water into a reservoir at an elevation above the river. By day it will be a power-generating plant. Reversible rotors will serve both as pumps and turbines.

Fig. 1 Two new power plants have been built by the New York State Power Authority as part of the redevelopment of hydroelectric power at Niagara Falls. The Tuscarora Plant is both a pumping and a generating installation which fills the reservoir at night and empties it during the day when electric demand is greatest.

Reversible

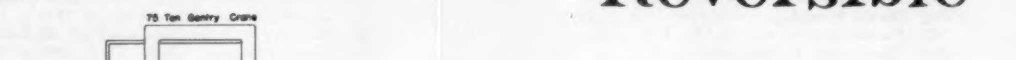


Fig. 2 Each of the 12 pump-turbine units at the Tuscarora Pump Generating Plant is rated 28,000 hp at 75-ft head as a turbine, 25,000 kva as a generator, 37,500 hp as a motor, 3400 cfs at 85-ft head as a pump. Speed is 112.5 rpm.

Fig. 3 Plate shop assembly of scroll case and stay ring for one of the 12 reversible pump-turbines built for the Tuscarora Plant

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Pump-Turbines at Niagara Falls

The redevelopment of hydroelectric power at Niagara Falls was made possible by the Treaty of 1950 between the United States and Canada. By the terms of this treaty, the amount of water flowing over the falls from April through October must not be less than 100,000 cfs during the daylight hours. This may be reduced to 50,000 cfs during the night hours in those months or on a 24-hr basis during the remaining months of the year.

Since the net average flow of the Niagara River is about 200,000 cfs (disregarding 5000 cfs which belong outright to Canada due to diversion elsewhere), 100,000 cfs will be available during the day from April through October, and 150,000 cfs the remainder of the time. This will be divided equally between the United States and Canada.

The difference in level between Lake Erie and Lake Ontario is about 326 ft. On the Canadian side, the Hydro Electric Power Commission of Ontario has made use of about 292 ft of this head in the Sir Adam Beck Plant built during the 1920's. Now, 16 Francis turbines have been added to this plant, each rated 105,000 hp.

The American redevelopment is being done by the Power Authority of the State of New York. Two new power plants are being built at Lewiston, N. Y.—the Lewiston Plant and the Tuscarora Pump Generating Plant. The Lewiston Plant will contain 13 Francis turbines, each rated 200,000 hp under 300-ft net head at best efficiency, and Tuscarora will have 12 reversible pump-turbines.

Unfortunately the additional 50,000 cfs of water available during the night hours for seven months of the year occurs during the period of low demand for power. If it were available in the daytime, it would add about 1,100,000 kw of additional power. This 50,000 cfs of water for 12 hr totals 2,160,000,000 cu ft of water.

Reservoir Needed

A 25,000-acre-ft reservoir about 1 sq mile in area and 60 to 70 ft deep in each country would make it possible to store this water at night for daytime use. A reservoir of this size was not practical at the forebay elevation, but it could be provided on the escarpment about 90 ft above the forebay of the Lewiston Plant. On the Canadian side it was also possible to provide such a reservoir about 90 ft above the forebay of the Sir Adam Beck Station. This requires the additional water to be pumped into the storage reservoirs.

The recent development of large, reversible pump-turbines, such as the 83,000-hp Hiwassee pump-turbine of the Tennessee Valley Authority, resulted in a decision

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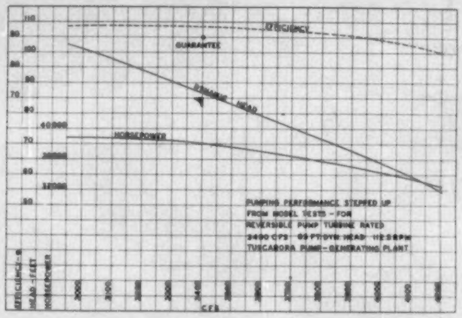


Fig. 4 Pumping performance stepped up from model tests for a 3400-cfs, 85-ft-dynamic-head, 112.5-rpm pump-turbine

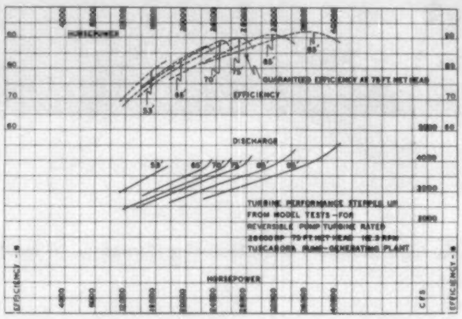


Fig. 5 Turbine performance stepped up from model tests for a 28,000-hp, 75-ft-net-head, 112.5-rpm reversible pump-turbine

to use reversible pump-turbines on both sides of the river for this purpose. The Hydro Electric Power Commission of Ontario has installed six vertical reversible pump-turbines in the Sir Adam Beck Pumped Storage Station rated to generate 40,500 hp under 85-ft net head. Each is a diagonal-flow propeller-type unit with adjustable blades, called a Deriaz pump-turbine. The Power Authority of the State of New York is installing 12 vertical reversible Francis-type pump-turbines, each rated to generate 28,000 hp under 75-ft net head at the Tuscarora Pump Generating Plant about one mile upstream from the Lewiston Plant. The net head for turbine operation will vary between 53 and 95 ft.

The intake for the Lewiston and Tuscarora Plants is in the City of Niagara Falls, N.Y., about $2^1/_2$ miles above the falls. The water will flow under the city through two tunnels about 46 ft wide by 66 ft high. These are cut-and-cover tunnels about 22,000 ft long made of reinforced concrete. The water will flow into a pool which will be the suction reservoir for the Tuscarora Plant. From there it will flow through an open canal to the forebay of the Lewiston Plant, Figs. 1 and 2.

The Pump-Turbines

The Tuscarora reversible pump-turbines will rank among the largest units of this type ever built. Each pump-turbine is rated to pump 3400 cfs of water against a dynamic head of 85 ft. The dynamic pumping head will vary between 57 and 99 ft. The pump-turbines will run at 112.5 rpm in a clockwise direction as turbines and counterclockwise for pumping. Each unit will have a welded steel spiral case with an 18-ft-diam inlet, Fig. 3. Due to its large size, the spiral-case segments will be welded to each other and to the stay ring during the assembly at the powerhouse.

Each of the runners will be more than 17 ft in diam and will weigh approximately 51 tons. Each runner will have six buckets and the lower portion of the buckets will be overlaid with stainless steel for protection against pitting. Six of the runners will be carbon-steel castings with the buckets cast integral with the crown and runner band. The other seven runners, including the spare runner, will be fabricated with carbon-steel cast buckets welded to a cast carbon-steel crown and runner band. The lower portion of these buckets will be stainless-steel segments welded to the carbon-steel buckets. The main shaft will be a 28-in-diam steel forging with a coupling flange bolted to the runner crown and an upper coupling flange bolted to the generator motor shaft. A stainless-steel sleeve is provided on the shaft where it passes through the packing box on the head cover. The turbine bearing is a babbitted type lubricated with oil by means of motor-driven oil pumps. There are 20 wicket gates made of cast carbon steel controlled by two servomotors with oil pressure of 200 to 300 psi.

A model of these pump-turbines was tested in the Company's hydraulic laboratory. Performance tests and cavitation tests for pumping and turbine operation were made on a pump-turbine model to the complete satisfaction of Uhl, Hall and Rich, Consulting Engineers, for the Power Authority of the State of New York. The ratio of model to prototype was 1 to 13.73. Fig. 4 shows the pumping performance stepped up from the model tests. The dynamic head, cfs, and hp are stepped up by the known formulas of ratio of diameters and rpm between model and prototype. The efficiency is stepped up by the Moody formula

$$E = 100 - (100 - e)\left(\frac{d}{D}\right)^{1/4}$$

as specified in the contract.

The turbine performance stepped up from the model tests is shown in Fig. 5. The hp and cfs (discharge) are stepped up without correction for any change in efficiency. The efficiency is stepped up from the model test by the preceding Moody formula. The calculated hydraulic thrust plus the weight of the runner and shaft is 330,000 lb. The estimated runway speed at 95-ft maximum head is 198 rpm.

Transient Behavior

Interest in the pump-turbine characteristics goes beyond the data shown in Figs. 4 and 5. In order to set a time for the closure of the gates, the transient behavior of the pump-turbine must be explored. The explorations are easier if the pump-turbine characteristics are arranged in synoptic curves. Fig. 6 is an example of such a curve plotted for a constant gate opening of 60 per cent. This corresponds to operating the Tuscarora Unit as a pump at its rated capacity of 3400 cfs, at a head of 86.5 ft, a speed of 112.5 rpm, and a torque of 1,775,000 ft-lb. These curves are usually plotted as percentages of some arbitrary rating to make them easier to apply to future applications of the same model. The capacity, head, speed, and torque given and used in Fig. 6 are the 100 per cent points.

at Niagara Falls

Each gate opening has a similar synoptic curve, and as the gate openings become smaller the synoptic curves shrink toward the rpm axis. If these synoptic curves are considered as horizontal planes spaced vertically according to the gate openings they represent, a three-dimensional characteristic exists having per cent rpm, per cent flow, and per cent gate opening as its principal axes. If a time for gate closure is assumed, a time scale may be substituted for per cent gate-opening scale.

An interesting application of this three-dimensional characteristic to a transient condition follows. The pump-turbine is pumping 3400 cfs, at 86.5-ft head, at 60 per cent gate opening, and power on the motor is lost. It is assumed that gate closure starts when the power is lost, and that the closure time from 60 per cent gate is 12.8 sec. This time is based on previous experience with units of this specific speed. The problem is to trace the speed, flow, and torque through this transient. This is done by solving for the amount of deceleration or acceleration the head on the machine can cause in the rotating masses of the unit, and in the water column in the penstock, spiral casing, and draft tube over a small increment of time. This means that step-by-step progression exists along the time scale of the three-dimensional synoptic curves, Fig. 7.

There are several points of interest on this curve. One is the time of rotation reversal. The time spent in rotating as a pump and flowing as a turbine is a little surprising. Perhaps the most interesting feature of the curve is the slope of the flow curve near 0.8 sec. This point is connected with the surge problem, if the lengths of the penstock and draft tube are such that a surge problem exists. Fig. 7 would be different, if the start had been made with maximum head or with minimum head. These conditions must also be checked before the assumed closure can be called final.

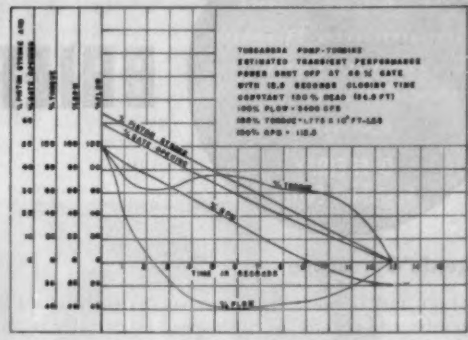


Fig. 7 Estimated transient performance of a Tuscarora pump-turbine. Power is shut off at 60 per cent gate with 12.8-sec closing time. Constant 100 per cent head = 86.5 ft, 100 per cent flow = 3400 cfs, 100 per cent torque = 1.775 × 10^6 ft-lb, and 100 per cent rpm = 112.5.

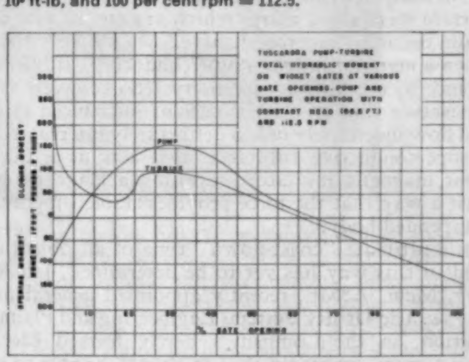


Fig. 8 Total hydraulic moment on wicket gates on the Tuscarora pump-turbine at various gate openings. Pump and turbine operation is at 112.5 rpm with a constant 86.5-ft head.

Prototype Design

A large amount of the test work on this model was used to obtain data for the design of the prototype. From the beginning, wicket gates have been a problem because they must be designed for flow in both directions. The moment characteristics of a normal turbine wicket are much higher when it is subjected to pumping. The value of maximum-moment pumping may be as much as three times the value of the maximum-moment turbining. The problem has been to design a wicket that has reasonable moment characteristics both for turbining and pumping. Fig. 8 shows the moment characteristics of the Tuscarora wickets operating under rated-head conditions. The curves in Fig. 8 represent a good compromise between pumping and turbining operation.

The moment characteristics change as the head changes. This made it necessary to obtain moment data at both the maximum and the minimum head conditions before the wicket-gate design could be proved.

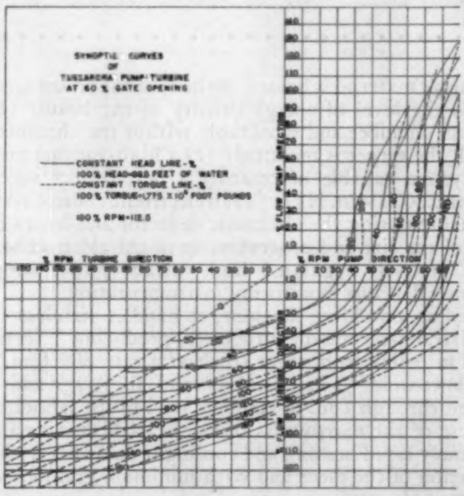


Fig. 6 Synoptic curves of a Tuscarora pump-turbine at 60 per cent gate opening. (——— = constant-head line, per cent, where 100 per cent head = 86.5 ft of water; - - - - - = constant-torque line, per cent, where 100 per cent torque = 1.775 × 10^6 ft-lb; 100 per cent rpm = 112.5).

Conclusion

Since there are only a few reversible pump-turbines in operation, the model tests in the laboratory had to be quite complete in determining not only the performance for pumping and turbining, but such other factors as cavitation, wicket-gate moments, and transient behavior in case of power failure.

Each new installation will add to the general knowledge leading to further improvement of this comparatively new type of prime mover.

Abstracts and Comments Based on Current Periodicals and Events

D. FREIDAY
Assistant Editor

BRIEFING THE RECORD

Cryogenic Gyroscope

A SMALL metal body has been successfully suspended in a vacuum and rotated at high speed essentially without friction as a step toward the development of a super-accurate inertial-guidance device by the General Electric Company.

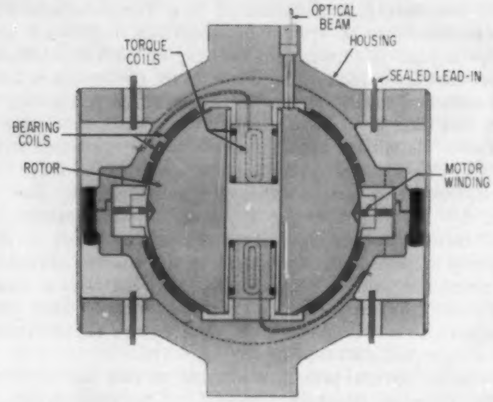
The development makes use of characteristics exhibited by certain metals and alloys which at extreme low temperature become "superconductive."

When a material becomes superconductive, it offers no resistance to the flow of electricity. So complete is its nonresistance that an electric current introduced into it would flow indefinitely unless deliberately interrupted.

A superconductive substance also acts as a highly efficient magnetic insulator—repelling a magnetic field in such a way that the force provides stable support for the suspended body.

While ultimate "coast-down" time of an object suspended in this way has yet to be determined, James F. Young, Mem. ASME, recently appointed general manager—Electric Utility Systems Engineering and Planning Operation, in the Company's newly formed Electric Utility Group, estimated that it should be able to spin freely for many months "or even years" after once being set in motion.

Significant accomplishments from company-sponsored research in the area of superconductivity at a cost of $2 million and the company-financed feasibility tests have led to Project Spin. This is a development contract with the Army Ballistic Missile Agency which looks to the perfection of a revolutionary "cryogenic gyroscope."



According to G. A. Hoyt, Mem. ASME, Ordnance Department general manager, this would be many times more accurate then the best conventional gyros. He states: "The reason is that in the cryogenic gyro the general causes of unpredictable gyro error will have been either eliminated or reduced to negligible factors. The world of supercold is a dead world where no chemical or organic change takes place."

The increased accuracy is seen resulting from elimination of mechanical bearings, reduction of friction and

Electron-Beam Welding-Machining

A NEW Hamilton-Zeiss electron-beam machine can machine or weld the hardest materials or metals. It can cut holes finer than the diameter of a human hair, or surface-treat, melt, or weld virtually every known material including tungsten and the exotic new metals.

Developed in the postwar years by the Carl Zeiss Foundation of Oberkochen, West Germany, the equipment has welded through inch-thick stainless steel in a few seconds in laboratory tests and has welded through $^1/_2$-in-thick stainless steel in production applications. It has demonstrated major improvements in such critical areas as the welding of reactor cores for atomic-energy installations and the milling of subminiaturized electronic components.

The electron-beam process uses a controlled high-density stream of electrons to change matter physically or chemically. A typical installation comprises six basic elements: (*a*) An electron gun which develops a precisely controlled beam of electrons of high-energy density that can be directed to do work on a target—the target material is heated, melted, or vaporized according to the level of energy density in the beam; (*b*) a vacuum chamber and worktable within the chamber on which the target is mounted; (*c*) a high-vacuum pumping system capable of creating a near-perfect vacuum (about 0.000004 in. Hg); (*d*) an electronic control system for manipulating the electronic deflector and lenses that control the size and programming of the electron beam; (*e*) a precisely regulated high-voltage power supply; (*f*) miscellaneous monitoring instrumentation.

Used as a welding machine, it handles stainless steel for aircraft and missile structures, producing T sections 0.060 in. thick from sheet stock at a rate of 2 fpm. It will butt-weld $^3/_8$-in. stainless steel at $^1/_3$ ips and has welded through 1 in. of stainless steel in the laboratory. Because of the narrowness of the heat-affected area and extremely rapid heating and cooling it does this without distortion of the piece and with minimum grain growth in the weld area.

When used for machining, the process permits creation of accurate holes and slots in the hardest materials as small as about 0.0008 in. Energy density during drilling

Gyro housing and spherical rotor, on table, operate in a vacuum at a temperature near absolute zero produced by the liquid nitrogen

electrical losses "almost to zero," and heightened dimensional stability induced by very low temperatures.

A navigation system containing a superconductive gyroscope would permit a submarine or land vehicle to determine its exact position at any point on earth with a precision not otherwise possible except through time-consuming measurements. Such positioning would include highly accurate orientation to true north, necessary for the most exacting accuracy in missile firing. If this high accuracy could be applied to golf, it was pointed out, it would make possible a hole-in-one every time.

A golfball-size sphere is presently being readied for advanced tests at rotation speeds up to 20,000 rpm inside a high vacuum with a temperature only four degrees above absolute zero (−460 F).

A company spokesman stated that the uses of superconductive materials for practical purposes are at their very beginning. A superconductive magnetic lens applied to an electron microscope, for example, should increase resolution enormously and make it possible actually to see an atom.

Other future possibilities are highly stable frequency and time standards, microminiature switching units for shoebox-size computers, extremely accurate measurement standards for electric current, noiseless and drift-free d-c to a-c amplifiers, and superconductive power lines that could carry "perhaps 10,000 amp of electricity" over a $^{1}/_{2}$-in. cable.

To further this cryo-gyro work and other superconductive applications, the General Engineering Laboratory has just completed a $100,000 low-temperature facility. It is equipped with six cryostat stations, each

Once set in motion, the golf-ball-size sphere which engineer Karl F. Schoch, Assoc. Mem. ASME, holds will rotate for years suspended solely by a magnetic field

capable of maintaining temperatures near absolute zero.

Each station is provided with an automatic control system for setting and maintaining the helium-bath temperature, which produces near-absolute-zero atmosphere, and other features such as piped-in gases and means for obtaining high vacuum at low temperatures.

An additional feature is the provision for safe use of small quantities of liquid hydrogen. This allows economies in the use of the more costly liquid helium, and permits experimentation at temperatures in a range above that obtainable with liquid helium.

runs as high as (equivalent) 600 million watts per sq in.

Hamilton Standard, a division of United Aircraft Corporation, Windsor Locks, Conn., will begin manufacturing the electron-beam machine in 1960 under terms of an exclusive agreement with Zeiss.

Canadian Hydroelectric Progress

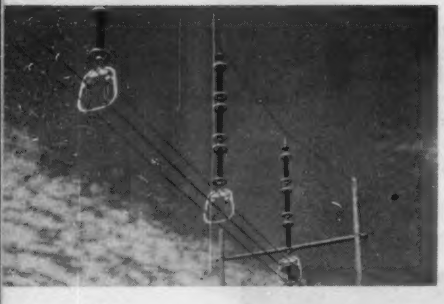
For the second consecutive year, a record was established in the amount of new hydroelectric generating capacity brought into operation during a period of one year in Canada. According to the annual report on hydroelectric progress by the Department of Northern Affairs and National Resources, Water Resources Branch, a total of 2,508,800 hp of new capacity was added during 1959, exceeding the previous record of 2,485,040 hp completed during 1958 and surpassing, by far, the earlier record of 1,758,450 hp of new capacity which was brought into service during 1954.

Other installations which are currently under construction are expected to add about 1,700,000 hp during 1960, while an additional 2,300,000 hp of new capacity are either under construction or in active prospect for development in succeeding years.

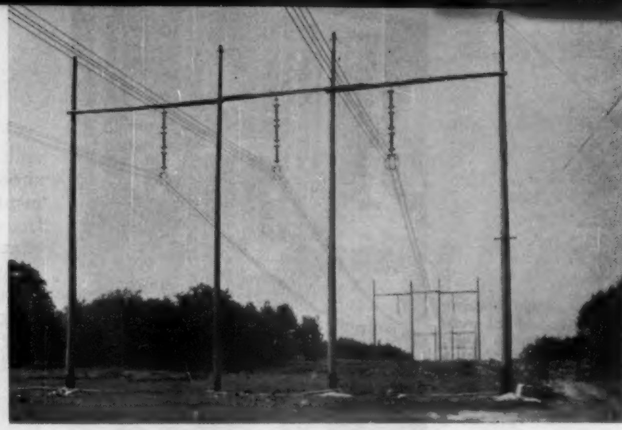
Major installations during 1959 were made at the Robert H. Saunders—St. Lawrence Generating Station of the Hydro-Electric Power Commission of Ontario, where the nine remaining units totaling 675,000 hp were placed in service; at the Chute des Passes generating station of the Aluminum Company of Canada, Ltd., where three units totaling 600,000 hp commenced operation; and at the Bersimis II generating station of the Quebec Hydro-Electric Commission where three units totaling 513,000 hp were placed in service.

The total installed capacity of water-power plants in Canada is now listed at 24,884,848 hp, which is less than 30 per cent of the feasible turbine installation based on the country's estimated water-power resources.

The Province of Quebec led all other provinces in the amount of new hydroelectric capacity installed during 1959. A total of 1,457,800 hp of new capacity was placed in operation during the year, while additional capacity under construction will add 1,100,000 hp during 1960 and a further 1,000,000 hp later.



Grading rings suppress corona on conductor and insulator hardware of Ontario Hydro EHV line



North test line uses a bundle of four conductors per phase

EHV Research in Ontario

WITHIN the next few years, The Hydro-Electric Power Commission of Ontario plans to develop a group of hydraulic sites in a section of the Province remote from the heavy-load area.

To provide design information for the extra-high-voltage, EHV, transmission lines required, a high-voltage experimental station has been constructed near Coldwater, Ont. According to information furnished by H. H. Leeming, director of engineering for the Commission, the installation comprises two 3-phase bundled-conductor test lines, each about 2500 ft long, operating at voltages up to 600 kv phase-to-phase.

About 1200 mw of new hydraulic generation is being considered for incorporation into the existing system by two 460-kw circuits, each approximately 450 miles long, with an intermediate load center near the mid-point of the circuits. As the generation would be of low load factor, to be used mainly for peaking, the theoretical economic conductor size for these circuits is reduced to the point where relatively high surface-voltage gradients create special design problems associated with conductor corona.

The solution to this type of conductor design problem involves the application of more than one conductor per phase in a suitable bundle arrangement and the selection of a sufficiently large diameter for each of the conductors in the bundle. The conductor and its influence on the strength requirements for the towers have a very important bearing on the transmission-line cost, and must be selected with care. Although it is generally agreed that bundled conductors are required on lines of this voltage class, there is a lack of full-scale 3-phase test data on which to base precise designs. For this reason, the primary purpose of the experiments at Coldwater is to refine the methods of determining conductor size for these lines.

Incomplete system economic studies point toward the application of either three or four conductors per phase for this scheme. Four conductors per phase would be smaller and involve less total weight of conductor per phase than three. Since ice tends to build up on conductors of various sizes by more or less the same radial thickness, however, the four conductors per phase would require slightly heavier towers.

For the first series of tests, a bundle of four conductors per phase is being used on each of the two test lines with 1.1-in-diam conductors on one line and 0.8-in-diam on the other. The spans in the test lines are relatively short, approximately 500 ft, and therefore spacers are installed only at the mid-point of each span. The line structures are made of wood and are guyed.

Since the Coldwater tests are concerned primarily with conductor characteristics, efforts have been made to eliminate noise from extraneous sources. Hardware and corona-shield designs were evolved by means of laboratory tests of radio noise and visible corona, and similar tests were employed to verify the corona-free operation of the Langstab insulators used on the line structures. Early observations indicate that the conductor hardware is essentially corona free up to 600 kv.

Variations in the conductor arrangements will be made in accordance with results obtained as the radio-interference and corona-loss tests progress. Initial test conditions include a bundle spacing of 15 in. and phase spacings of 26 ft for the 1.1-in. conductor and 32 ft for the 0.8-in. conductor. In the later stages of testing, one of the 1.1-in. conductors probably will be removed from each phase to permit evaluation of a three-conductor bundle with the original 0.8-in. conductor bundle unchanged, for comparison.

A special steel tower simulates live-line maintenance operations and determines electric field strength at work locations and the electrostatic charges and shock currents to which linemen are subjected under various working conditions. These data will be co-ordinated with laboratory tests to determine the requirements imposed on climbing clearances, tool design, and working techniques.

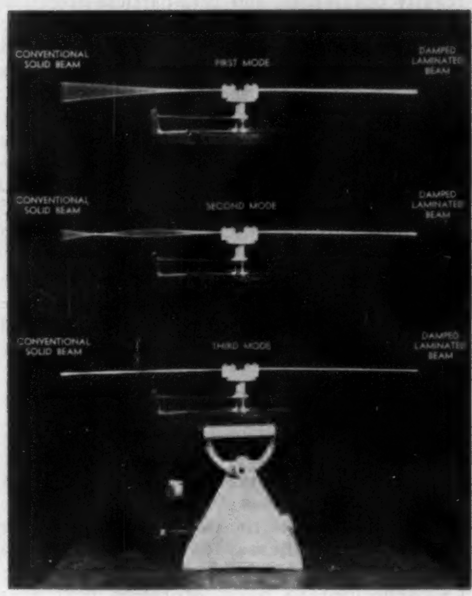
Some details of the high-voltage power supply to the test lines are also of interest. Power is supplied from a 44-kv line, through a 3-phase regulating transformer and a low-voltage breaker, to 3 single-phase high-voltage test transformers, each rated 15.7 kv/350 kv, 1667 kva. These transformers are equipped with 345-kv bushings, impulse-tested to 1300 kv. With these bushings, the transformers can be operated continuously at voltages up to 500 kv. Operation between 500 and 600 kv is limited to 2 hr in 8, because of possible overheating from bushing dielectric loss.

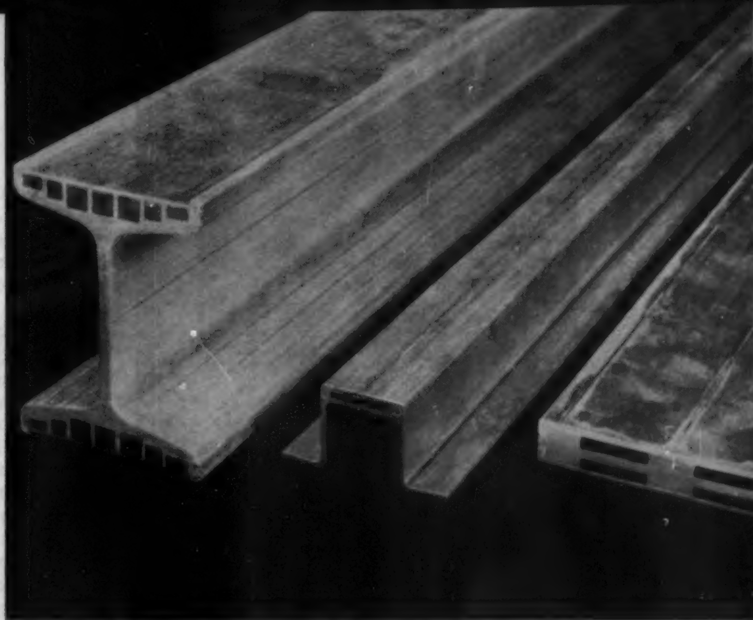
The high-voltage bus in the power-supply area also consists of a 4-conductor bundle, each conductor being 1.34 in. in diam. Special disconnecting devices are used in the high-voltage bus so that tests can be made on either or both of the test lines. These are operated manually by means of magnesium operating rods which can be left in position for ground connections on the open line.

Instrumentation is provided for meteorological observations and to measure corona losses and radio interference, both generated RIV and radiated RI. Insulator losses are measured on a short single-phase stub bus near the power-supply area.

Conductor aging has now progressed to the point where useful data are being obtained from a regular program of RI and corona-loss testing.

Top, at 17-cps sinusoidal vibration input, the conventional beam amplifies vibration by a factor over 100, Rigidamp about 10. **Center**, at their first harmonic frequency, 105 cps, conventional-beam vibration amplification exceeds 100, Rigidamp is about 3. **Bottom**, at second harmonic, 300 cps, the damped beam appears stationary while conventional-beam amplification is 50 times as great.





The resonant response of Rigidamp aluminum structural members is drastically reduced by the incorporation of steel inserts with viscoelastic damping medium at the interface of cell and insert. The viscoelastic layer absorbs dynamic energy when the beams flex under impressed vibration.

Viscoelastic Damping

The art of noise and vibration control is receiving severe tests with the extreme vibration problems created by modern high-energy power plants, particularly those for aircraft and missiles. These create large dynamic stresses and, in addition to transmitting high accelerations to sensitive and critical components, cause serious problems of structural failure due to fatigue.

Barry Controls, Inc., has built up a $5-million-gross-per-yr business in eliminating fatigue failures and malfunctions caused by shock, vibration, and noise. A company-financed research program has produced a method of reducing the resonant response of structures by incorporating controlled damping within the structural members themselves.

The method hinges upon the use of a viscoelastic damping layer whose composition is a proprietary secret. This is sandwiched in laminated sheet or plate, or incorporated between the base material and cell inserts in such other structural shapes as channels and I-beams or honeycomb-sheet fabrications.

In flexing under impressed vibration, the separate laminations of structural material slide relative to each other. This sliding is impeded by the specially formulated viscoelastic material, and most of the energy of resonance is absorbed in straining the viscoelastic layer in shear.

The Shock and Vibration Committee of the ASME Applied Mechanics Division held a colloquium on structural damping at the 1959 Annual Meeting.[1] The seven papers that were presented have been published as a separate volume and were edited by Barry's staff engineer, Jerome E. Ruzicka, Assoc. Mem. ASME. He and another Assoc. Mem. ASME, R. D. Cavanaugh, chief of the company's technical staff, were coauthors of a paper on "Vibration Isolation of Non-Rigid Bodies" presented at the 1958 Annual Meeting colloquium on "Mechanical Impedance Methods."[1]

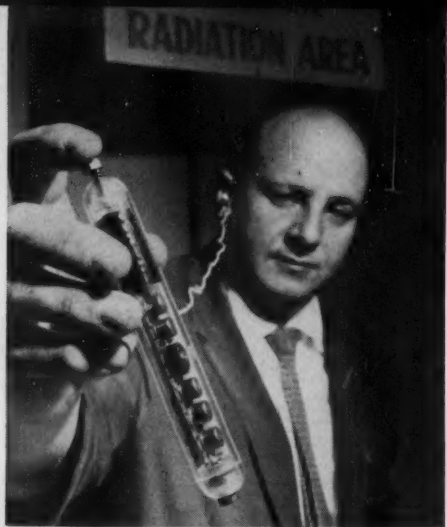
Where damping is incorporated into the structure, all portions of the structural fabrication act as load-carrying members, and materials and structures can be designed for virtually optimum damping characteristics in all frequencies normally encountered in modern dynamic vibration. The company has delimited −50 to +300 F and a frequency range up to 2000 cps as its area of interest.

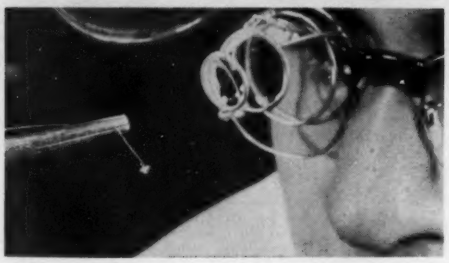
For that range it has developed a series of viscoelastic compounds to meet design requirements for various geometries which allow stiffness, weight, and damping to be considered as related requirements. The specific damping energy of the typical viscoelastic damping material is several hundred times that of the typical structural material for all stress levels considered.

A structural design that is highly damped generally weighs more than a conventional design when compared on the basis of equal static stiffness. However, resonant vibration control by use of a common design procedure, such as structural rigidization, results in an overdesign for static loads. By applying structural-damping techniques, the stiffness property of the structure need only satisfy static-load requirements. Therefore a weight less than that of the rigidized structure may be obtained by the use of structural damping.

The company has also devised special know-how in production and application which it supplies its customers as a package service along with its special materials. The trade mark Rigidamp has been registered and patents have been applied for on each type of construction. The way to handle the larger applications beyond its manufacturing capability has yet to be decided.

[1] The Proceedings of both colloquiums are available from the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Structural Damping is $4.25, Mechanical Impedance, $5.50. Both are available to ASME members at 20 per cent less.





Cigar-sized tube, **top**, contains radiation detector, battery, and amplifier. Doped-silicon detector, **bottom**, is smaller than a pinhead. Device depends upon an excess and a deficit of free electrons in adjacent regions of the lattice structure of the silicon. Regions are created by the diffusion of phosphorus into the silicon. When radiation strikes the surface, the excess electrons move into the adjacent area where the deficit exists. This movement constitutes a measurable electric current.

Solid-State Ionization Chamber

Radiation detection ranging in application from nuclear-physics experiments to industrial-process control will be vastly simplified and improved by a solid-state ionization chamber smaller than the head of a pin developed and produced by the Hughes Aircraft Company, Los Angeles, Calif.

The detector is essentially a slice of doped silicon so thin that it is barely discernible. When struck by a charged particle it emits a pulse which can be measured and analyzed. There is less than 0.5 per cent error in the analysis of the energy of the particle. The device operates at very low voltage, requiring no cumbersome power pack, and it detects particles 1000 times faster than previous instruments.

In the solid-state ionization chamber, a p-n junction is formed close to one surface of a slab of high-resistivity p-type silicon by a shallow diffusion of phosphorus. A reverse bias is established across the junction, which in turn establishes a depletion region (space-charge region) on both sides of the junction. For optimum operation, the n-depletion-region width should approach the diffusion depth, and the width of the p-type-silicon section should approach the physical depth of the silicon slab. In practice, the maximum width of the total-depletion region is limited by the magnitude of the voltage that may be applied.

Previously, ion chambers have been much more complicated, and expensive devices in which the ability of nuclear radiation to cause ionization in passing through a medium, usually gas, were used as the basis of measurement.

The new device has been used as a detector and energy spectrometer for protons, deuterons, helium 3, alpha particles, and fission fragments. The detection of neutrons is readily obtainable, and beta-particle detection has been demonstrated but not fully evaluated. The energy resolution for alpha particles is presently limited by the noise level of the electronic system and represents an energy spread typically less than 50 kev.

Three-dimensional "packages" containing thousands of individual detectors coupled to electronic-data-handling equipment should replace costly bubble chambers (several million dollars) as a means of tracking particles. Space probes equipped with these packages would telemeter information back to earth, doing away with dependence on the recovery of the nose cone.

The use of radioisotopes for flow measurement, thickness gaging, liquid-level measurement, and similar applications should be greatly accelerated and broadened in scope by the reduced cost and increased sensitivity of the new ionization chambers.

Power-Plant Computer Record

The complex data-logging and computer system at the Sterlington station of The Louisiana Power and Light Company near New Orleans has operated virtually without stopping 24 hr a day for the past six months. The installation, which paved the way for the same company's fully computer-operated 230,000-kw station at Little Gypsy, La., scheduled to begin operation next year (Mechanical Engineering, May, 1959, p. 79), was in service 99.76 per cent of the time.

The few times that the equipment was out of service, maintenance personnel found that the trouble was in accessory equipment. Sterlington lost not one minute because of the failure of the computer manufactured by Daystrom Systems, La Jolla, Calif., although some 4000 transistors and 7500 diodes were involved in the equipment.

Test for Hot Cracking

A new metallurgical test has been devised to quickly discover hot cracking, a weakness which occurs particularly when metal alloys crack under the heat and stress of welding.

The test developed at Westinghouse research laboratories is simple, inexpensive, and thousands of times faster than other methods for predicting hot cracking. It is regarded as a major contribution to metallurgical research.

Previously, the only satisfactory test had been to prepare large samples weighing several hundred pounds and representative of the final structure and then actually to test-weld them. A single test might take weeks or months and cost hundreds or thousands of dollars in materials and time.

Deep grooves had to be machined into the surface in this slow and expensive procedure. Some of the sample alloy was made into wire and coated to form electrodes. Then the grooves were filled with the wire by hand welding.

Visual inspection or x-ray tests revealed any gross defects caused by hot cracking of the weld. However,

it was usually necessary to cut samples from the weld, polish them, etch them, and examine them under the microscope for tiny defects.

In six months of research hot cracking has been studied with the new technique in more than 800 samples of alloys, using only 40 lb of metal. Such samples weigh less than an ounce, and each test, from beginning to end, is completed in a matter of minutes.

The test is based upon the fact that the tearing of a metal casting as it cools and shrinks from a liquid into a solid is comparable to the cracking of a weld as it freezes. Therefore the study of small metal castings for hot-cracking susceptibility is equivalent to the study of welds in very large samples of the metal.

To prepare the large number of small castings required for the test, levitation melting is used. This is a metallurgical process discovered by Westinghouse several years ago in which a sample floats inside a high-frequency coil. In addition to providing support, this heats and stirs the metal.

After a 20-gram sample has been melted in a matter of 10 or 15 sec, it is cast into a slightly tapered pin that averages about 2 in. in length and $^1/_4$ in. in diam.

The top and bottom of the pin lock in place to prevent normal contraction of the metal, setting up tensile stresses in the pin as it cools and shrinks inside the mold. These stresses tend to cause the metal to tear apart. The longer and slimmer the pin, the greater the tearing. By comparing pins of different lengths and diameters, a numerical scale is built up to describe the susceptibility to hot cracking.

F. C. Hull, who devised the technique, calls it the "cast-pin tear test." It is particularly valuable in the development of new alloys and has been used in more than 3700 individual tests.

Changes in composition are constantly made during the development of an alloy for high strength, good corrosion resistance, and other desirable properties. With the new test, hot-cracking susceptibility can be quickly measured for each potentially valuable composition.

Microwave-Controlled Diesels

Five remote-control microwave-operated pumping or pressure-reducing stations make it possible for a man in the Los Angeles refinery area to start, route, measure, and stop the flow of up to 80,000 lb of crude oil per day through a 16-in. pipeline that originates 650 miles away in Southeastern Utah.

Ten model 4FS2 Nordberg Power Chiefs supply the power. They are 2-cyl, 4-cycle diesel units, rated 20 hp at 1200 rpm. Each drives a Kato 10-kw a-c generator with d-c exciter.

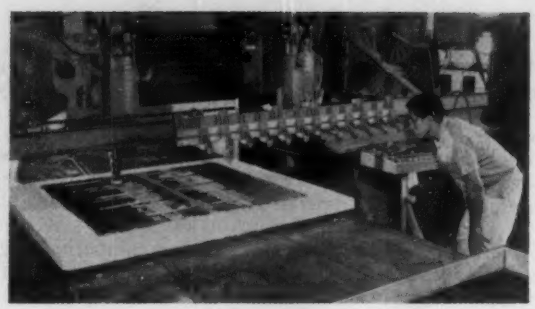
The 16-in. line originates at Red Mesa, Utah, at an elevation of 5270 ft, rises to 6690 ft at its highest point, and terminates at an altitude of only 15 ft in Compton, Calif. To boost the oil over the mountains, pressure is added to the flow. The cumulative weight of the crude at the base of the downhill slopes would be sufficient to rupture the line if two pressure-reduction stations were not used in addition to three pumping stations—all remotely controlled and largely unmanned.

Action is initiated all along the line by microwave radio, relayed from station to station. The depth of oil in a tank in Kingman, Ariz., can be learned by dialing a 2-digit number. Gages show the dispatcher the critical pressures and flow rates at various points along the line. If pressure at some point increases beyond a preset safe limit, the dispatcher is warned by both visual and audible alarms, and takes corrective steps—by microwave. When it is desirable, for example, to exercise the standby Nordberg diesel engine on Butler Peak, 76 miles away, a technician dials 29, code for Butler, followed by 47, code for an automatic switch, to start the standby engine. Or, by dialing 29 in combination with a long checkoff list of other 2-digit code numbers, other vital functions can be tested at the Butler repeater station.

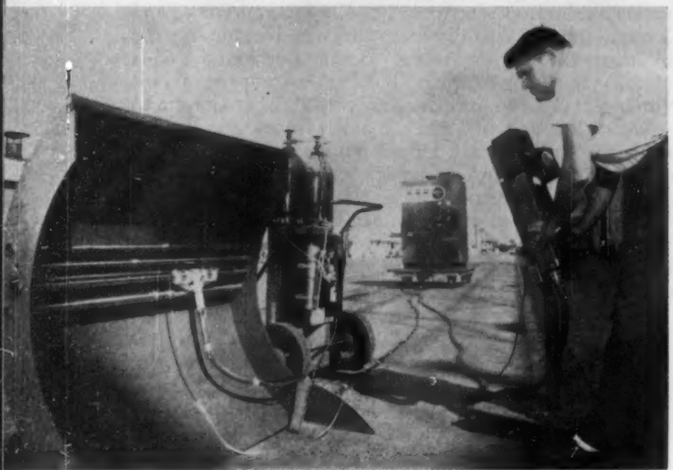
The normal procedure at the remotely controlled pressure-reduction stations at Kingman, Ariz., and Corona, Calif., is to dissipate pressure by running the oil through friction tubes. Seven horizontal, 65-ft sections of casing—called "bundles"—comprise a unit which reduces incoming pressure of 600 psi at Corona to between 200 and 300 psi. Smaller pipes are welded inside the larger ones. Thus a bundle exposes a considerable amount of surface to the friction of flowing oil, and by using different-sized bundles the pressure differential from suction to discharge can be controlled.

If, by some mishap, the pressure in the line from Corona becomes dangerously high, the flow can be diverted into a 55,000-bbl relief tank.

Ten model 4FS2 Nordberg Power Chief diesel engines supply the power for five microwave-operated pumping or pressure-reducing stations on a 650-mile-long crude-oil pipeline. All operations are initiated by microwave-radio control signals relayed from station to station.



Among new production methods developed for the all-steel plane is an ice chuck which holds honeycomb core for milling. Water poured over core is frozen to chuck bolted to the machine bed.



Remote induction brazing allows work to be done far from the generator

Edge-preparation machine handles sheet steel up to 16 ft wide, shearing it and turning up a lip as small as 0.012 in. for butt welding

All-Steel Airplane

When the triplesonic B-70 bomber was planned, only steel could withstand the expected 600-F skin temperatures, and much of the B-70 will be covered by sheet steel only 0.006 in. thick. Adding just 0.001 in. would increase the weight of the plane by a ton.

The basic surface structure decided upon was stainless-steel brazed honeycomb-sandwich paneling with the thin facing sheets brazed to a honeycomb core. Handling the thin sheet—which used to be considered foil—required special techniques as did nearly every stage in the processing. A vacuum table was used to determine the flatness of the steel sheets, and special vacuum chucks were used to hold the welded sheet flat in the stretch press.

The amount of welding was greater than in any previous airplane; there were more than 19,000 ft of fuel-tight fusion welds alone, and resistance spot welding was used extensively to join the various internal structural members.

While some parts had to be formed under heat approaching 1200 F, others were manufactured under subzero conditions by packing them with dry ice. These hot and cold sizing developments, along with progress in honeycomb-sandwich fabrication, won a medal for North American from the American Society for Metals.

The honeycomb-sandwich paneling was made from a new stainless steel, PH 15-7 Mo, a precipitation-hardening 15Ni-7Cr steel with some molybdenum and other alloying elements. It is heat-treated as part of the brazing cycle to a minimum yield strength of 200,000 psi and an ultimate tensile strength range of 225,000 to 260,000 psi.

Even the hydraulic system for the B-70 required special techniques and tooling to form hardenable corrosion-resistant steel tubing that would withstand 4000 psi but not increase the weight of the airplane.

Type AM 350, a precipitation-hardening, high-strength stainless steel was selected. And a special program was set up to determine the feasibility of forming, flaring, and swaging steel tubing in both the fully hardened and annealed conditions.

Induction brazing techniques and specially designed sleeves were used to produce tubing joints that eliminated threaded or flared-type fittings and saved over 1000 lb in the total weight. High-frequency electric current melts the brazing material inside a sleeve placed over the joint, and a leak-proof, high-strength coupling results. Heat is applied so rapidly—in from 7 to 10 sec—that the heat-treat properties of the tube are not affected.

Although the method of brazing is not new, the use of remote induction heating is. The induction coil can now be as much as 100 feet from its generator, permitting brazing to be done right on the airplane during fabrication.

Ships With Rubber "Tires"?

Pondering why porpoises can swim so swiftly with so little apparent effort led to the development of a specially designed rubber coating which reduces the turbulence normally created as an object moves through the water. Vessels are able to travel faster without any increase in power, and research is under way to apply this same principle to planes or other objects in flight and to liquids or gases flowing through pipes.

Max O. Kramer, vice-president of Coleman-Kramer, Inc., Los Angeles, Calif., an authority on boundary-layer stabilization by distributed damping, is the inventor.

The United States Rubber Company believes the development will be as important to water transportation as the pneumatic tire now is to land transportation and foresees a whole new area of interest opening up for the rubber industry.

The company's rubber technologists have already developed coatings which have reduced drag by about 50 per cent on underwater measuring devices, although greater reductions are theoretically possible.

Wide application is foreseen for pleasure craft that plane on the water, although larger surface vessels such as freighters, tankers, and passenger liners are less likely to benefit now from the coating because these ships generate large bow waves. However, changes in marine design and use of the coating might overcome this.

Many compounds and designs have been tried. The most practical development thus far is a thin layer of rubber supported by a multitude of tiny rubber pillars. Interconnecting channels between the pillars contain a freely flowing viscous liquid. The channels face the surface of the object. The outside, or water side, of the coating is smooth. The channels give the coating flexibility, and the liquid provides the necessary damping to suppress potential turbulence.

High-Speed Rotor Balancing

A HIGH-SPEED dynamic-balancing machine capable of balancing 7-ton rotating units at 12,000 rpm has been installed by De Laval Steam Turbine Company, Trenton, N. J. The machine is sensitive to bearing vibrations of the order of 0.000004-in. displacement of center of gravity. It can readily detect, for example, on a 5500-lb rotor spinning at 4000 rpm, unbalance as small as one gram at 10 in. from the axis of rotation.

The machine will automatically indicate where weight should be added or removed to bring a rotating component into near-perfect balance.

A substantially higher degree of precision is offered by the new machine because it can automatically balance high-speed rotors at or near their eventual operating speed rather than at the low speeds formerly used.

The D-67 Electro Dynamic Balancing Machine was built by Carl Schenck of Darmstadt. It is designed to accommodate weights from 200 to 14,000 lb and for balancing at speeds from 1000 to 12,000 rpm. This speed range permits both preliminary balance correction, and final precision high-speed balancing, to be done on the same machine. The machine has self-aligning bearing supports with equal rigidity in all directions. A hydraulically operated damping system permits a variable degree of flexibility for close simulation of a rotor's in-service bearing conditions.

The machine continuously indicates unbalance graphically and numerically. It displays in graphical form the amount of unbalance and its angular location, and shows the numerical values of horizontal and vertical components in any two preselected planes. It also continuously indicates the amount of force acting at each of the machine's bearings.

The machine, presently on the test floor, is driven through a dual-range speed-increasing gear by a special De Laval steam turbine. Later, it will be reinstalled in a vacuum chamber to permit high-speed precision balancing of bladed turbine and compressor wheels.

Competitive Air Cargo?

CARGO shipment by air, still relatively limited, is the "sleeping giant" of commercial aviation, according to J. R. McGowen, Douglas Aircraft Company vice-president speaking at the Charlotte, N. C., Engineers Club.

"Technically the airplane is ready. Turbofan and turboprop cargo airplanes can be delivered within two to three years which can cut operating costs in half.

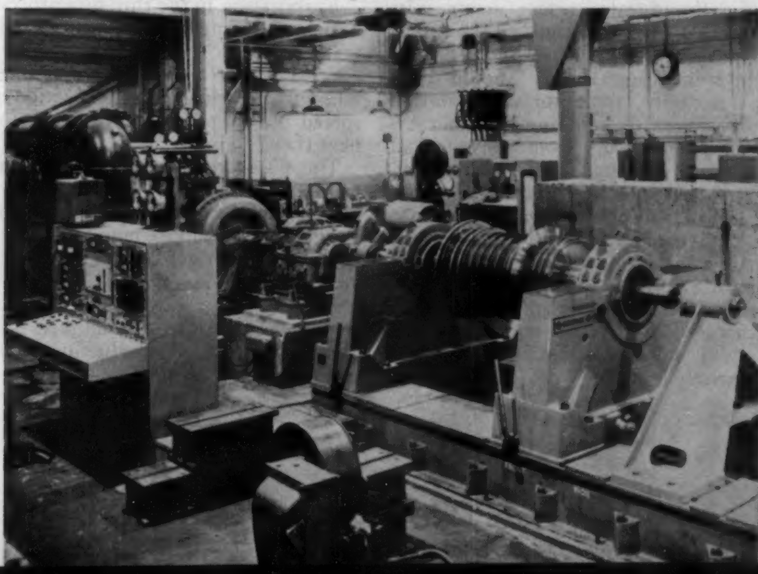
"Fully mechanized cargo-handling systems will be developed with automatic sorting, routing, and billing. Domestic air-cargo rates will drop first to about 14 cents per ton-mile, as compared to about 21 cents at present. As volume increases, air rates will drop to about 10 cents which will approximate truck rates and offer serious competition to other surface carriers."

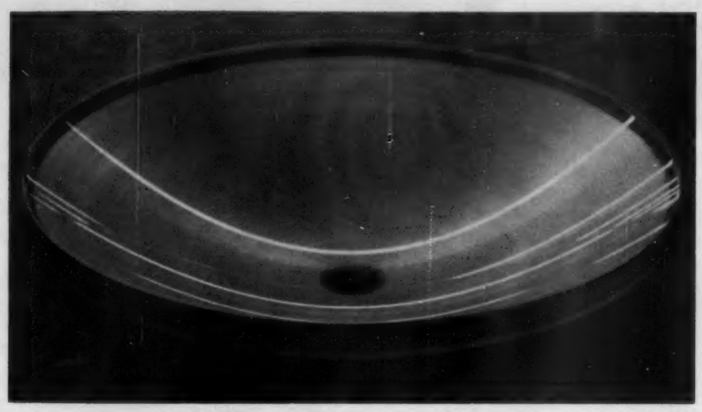
A shortage of capital on the part of the airlines, who have invested heavily in passenger transports, was cited as the principal factor holding back air-cargo growth.

McGowen foresaw the advent of supersonic carriers by about 1970, cruising at Mach 3, about 2000 mph, and said that it was conceivable this step would be eliminated in favor of rocket power and speeds of about Mach 10, or 6000 to 7000 mph, by about the same time.

The problem manufacturers will face in financing a supersonic transport was emphasized with the comment: "The Douglas Company's DC-8 has cost over $250 million in development alone. The radical supersonic transports of the future may cost several times that much to develop. The future ability of any company or consortium to invest these giant sums is problematical."

A high-speed dynamic-balancing machine recently installed at the De Laval Steam Turbine Company can readily detect an unbalance as small as 1 gram at 10 in. from the axis of rotation on a 5500-lb rotor spinning at 4000 rpm. It is capable of balancing 7-ton rotating units at 12,000 rpm and automatically indicates where weight should be added or removed.





The simple physical principle that the surface of a liquid spun about a horizontal axis assumes a paraboloidal shape is being used to improve the surface accuracy of antennas. A synthetic-resin face spun in this way results in irregularities of less than 0.005 in.

Spincasting Accurate Surfaces

Spincasting of a synthetic resin face upon large antennas promises to improve surface accuracy by more than an order of 10. The process is in the advanced development stage at D. S. Kennedy & Company, Cohasset, Mass.

In designing large antennas, reflector surface accuracy should not deviate from the ideal curve of a parabola by more than $^1/_{16}$ of a radio wavelength—$^1/_2$ to $^3/_8$ in. for a paraboloid to be used at a few hundred megacycles.

Although it has been practical to manufacture large paraboloids to these tolerances, cost increases by about the square of size and requirements for new frequency bands cannot be met by present methods.

The basis of the Spincasting process comes from natural phenomena. The surface of a pool of any liquid, spinning horizontally about a vertical axis, will, under centrifugal force and gravity, assume a paraboloidal shape with a focal length dependent upon the speed of the spin. The pool of liquid assumes its characteristic surface contour even if the bottom of the container is badly distorted. It follows, then, that the container could be a paraboloidal dish with its normal irregularities and that the liquid would, in effect, smooth out the distortions and increase the surface accuracy.

The problem is to get the liquid to take a cast, and the new synthetic resins provide an answer. The liquid resin is mixed with a suitable catalyst at the beginning of the spin. As the liquid-resin surface assumes its shape it gradually hardens until at the end of the operation it has become rigid.

Theoretically, the spincasting surface should be a perfect paraboloid. Actually, some surface deviation does occur due to vibration of the spinning table, but it is small compared with what occurs from conventional methods. Irregularities of less than 0.005 in. are possible, which makes this new surface usable to better than 75 kilomegacycles. Spun plastic paraboloids up to 3 ft in diam have already been designed by the University of California for the Atomic Energy Commission for use as light-gathering devices.

The practical limit to the size of the antenna that can be built by spincasting is dictated mainly by the problem of building a suitable spinning table; 60-ft paraboloids seem entirely feasible.

Kennedy at present has 10-ft dishes on the spinning table with plans for larger reflectors under way. Although many questions about the actual application of these new surfaces to practical antenna use remain unanswered, none of the problems that have appeared so far seem insurmountable. Antenna performance should be ready as new frequency bands are utilized.

Thin-Film Distillation

General Electric has been awarded a contract by the Navy's Bureau of Ships and the Department of Interior's Office of Saline Water for feasibility work on its new process for extracting fresh water from the sea.

F. J. Neugebauer, Mem. ASME, consulting engineer on thermal systems, is largely responsible for the evolution of the unique wiped thin-film technique which is expected to produce substantial improvements in over-all heat-transfer coefficients.

The equipment includes a concentric, vertical-tube distillation unit that is fluted on the outside and has a thin film of salt water spread on the inner surface of a heat-transfer tube by slowly rotating wipers. Heat is provided by steam introduced on the outside of the tube and the transfer of heat through the wall of the tube causes the salt water to evaporate. Pure water in the form of vapor leaves the evaporating chamber and the concentrated brine drains off.

Evaporation in the thin-film process takes place without the bubbling normally associated with conversion of water to steam, eliminating mineral-particle carry-over.

Scale depositing—a major problem in the past—is minimized by the mechanical action of the wipers which spread the thin evaporating film of salt water over the heat-transfer surface.

The fluted tube helps eliminate the inefficient heat transfer caused by an insulating film of condensed steam on the entire surface of smooth-surfaced tubes. With the fluted tube, surface tension pulls condensed steam into the grooves, stretching the condensed film on the flute crests so that it is very thin.

For marine applications, the system's substantial improvement in heat-transfer rates is of major importance and may result in a reduction to half the space and weight of conventional systems.

Thermoelectric A-C Production

THE first successful conversion of heat directly into a-c electricity in significant amounts, without use of rotating machinery or d-c a-c converter, has been reported by General Atomic Division of General Dynamics.

Experimental thermoelectric devices have previously been used to produce d-c, but an appreciable quantity of the more widely used a-c had not been achieved.

A high-temperature cesium-cell converter produced sufficient a-c electricity to illuminate a series of small light bulbs. Although the experiment is regarded as brightening the prospects for direct-conversion methods in power plants, considerable research and development work are needed before this would be practical.

The steadily expanding General Dynamics program of thermoelectric research, which has been under way since 1957, is partially supported by nine investor-owned utility companies of the western states.

Small Turbojet

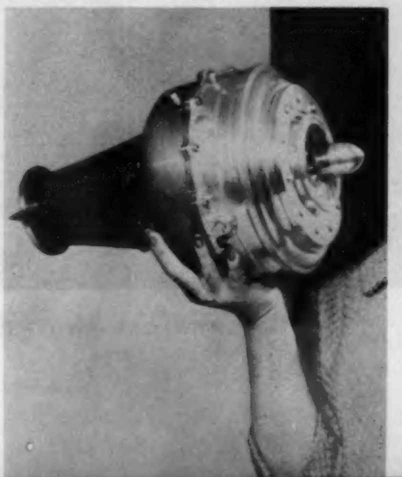
A TURBOJET engine weighing only 23 lb and producing 70 lb of thrust has been announced by the Williams Research Corporation, Walled Lake, Mich.

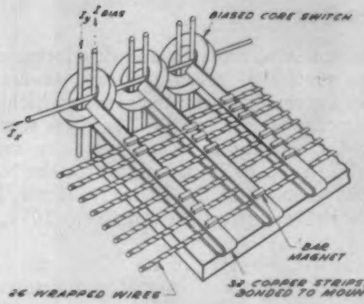
Company president Sam Williams, Mem. ASME, said the small engine could bring jet power to the light airplane industry since it approaches the thrust-per-lb ratings of the huge jet engines powering commercial transports and military aircraft. It could be used on military-target and drone airplanes and may also answer the helicopter designers' dream of an efficient engine small enough to be mounted on each of the tips of the rotor blade of a four-place helicopter.

The engine is small enough to submerge in the wing contour and low enough in cost to allow the use of several units per aircraft. Multiple engines are required because 300 to 400-mph light airplanes powered with turboprop engines or jet engines would have high take-off and landing speeds requiring too much pilot skill to satisfy the major market. As a result, numerous short-take-off-and-landing systems are being investigated.

The jet employs a 4-to-1 centrifugal compressor, an annular combustion chamber, and a single-stage axial-flow turbine. It has an operating speed of 59,000 rpm. Although the mechanical problems associated with high-speed operation have not been serious, considerable development work has been necessary to achieve high aerodynamic efficiency with the miniature components. The small jet engines that have been operated both in France and in this country have weighed from five to ten times as much as the Williams unit.

A 23-lb turbojet is small enough to submerge in the wing contours or to be mounted on the tip of helicopter rotor blades, yet produces 70-lb thrust





Hair-thin wires wrapped with magnetic metal tape and tiny bar magnets are the basis of a new memory

Magnet-Twistor Memory

AN ACCURATE and fast permanent electronic memory has resulted from closely co-ordinated research-engineering work at both Bell Laboratories and Western Electric.

Hair-thin wires wrapped with magnetic metal tape in barber-pole fashion plus tiny bar magnets are the basic elements. The new memory, which is ready for mass production, is comparatively inexpensive, easy to produce, and will help speed up computer developments. The memory will supply bits of information to a computer at speeds in millionths of a second.

A typical memory unit is built up of alternating grids of magnetic wire strands called "Twistors" and plastic cards with arrays of minute bar magnets.

The Twistor is a thin, hairlike copper wire, around which is spirally wrapped a magnetic tape $^1/_{10}$ of the thickness of the wire itself. The magnet array is formed by bonding a thin sheet of magnetic material to a plastic card and then removing all undesired magnetic material by precise photo-etching methods. The finished card stores information in much the same way as a punched card in an office calculator or computer.

In a punched card, information is stored by the presence or absence of a hole. Similarly, the new Magnet-Twistor memory retains information by the presence or absence of a bar magnet at a specific location on the plastic card. By inserting a new card with a different arrangement of magnets, the memory can be easily and reliably changed to a new program when required.

When a punched card is inserted into a calculator, an electric current flows where the card is punched and does not where there is no hole, providing information to the calculator. When a Magnet-Twistor memory card is read by a computer, an electric pulse is transmitted if there is no magnet or blocked if there is a magnet.

These electric pulses represent commands to the computer, telling it how to proceed in solving problems with accuracy and extreme speed of operation.

Tungsten for High-Temperature Coatings

HIGH-PURITY tungsten can now be easily plated on metal surfaces by using a vapor-deposition process which the National Bureau of Standards has developed for the Navy. The method, devised by W. E. Reid and A. Brenner of the Bureau's electrodeposition group, involves reducing gaseous tungsten hexafluoride with hydrogen by passing it over the heated object to be plated. At temperatures above 300 C (572 F), tungsten is deposited on the hot surface, and the only other reaction product, hydrogen fluoride, passes out with the excess of hydrogen.

Effectiveness of R & D

Can the effectiveness of research and development be measured? More precisely—given a certain amount of research effort, in a given field, can the rate at which useful results will emerge be predicted? These are some of the questions asked during a recent intensive study, "Basic Research in the Navy," carried out for the Naval Research Advisory Committee by Arthur D. Little, Inc., and reported in the company's November, 1959, *Industrial Bulletin*.

In the report to the Secretary of the Navy, the Committee recommended further "research on research." One approach is through a mathematical model describing the mechanisms of discovery and application. Although the work represents a first approximation, it appears to fit well the relatively meager data available.

Mathematical Model. The model describes a two-stage process. In the first stage, knowledge is discovered and brought from the realm of the unknown into the known. In the second stage, combinations of the known facts are fitted together and applied. Formulation of the inventive process in this way highlights one important point. For every invention there is a key fact, or relation, or principle—the last to be discovered of all those necessary before invention could be made. From this it follows that the date of discovery of this key fact is the earliest date upon which the invention could be made at all—although, of course, many inventions are not made until long after the discovery of the key fact.

There is a body of available knowledge, containing a certain number of key facts, corresponding to an essentially equal number of possible inventions. If no new knowledge is added by research, these represent all the inventions which can be made. But the more research effort is applied, the more new facts come to light, or in other words the rate of discovery is proportional to endeavor. It is also proportional to the size of the pool of (undiscovered) knowledge. The consequences of this proportionality are interesting. The equation describing the rate of depletion of basic knowledge—the unknown subject—is an exponential decay curve such as that used to describe the rate of decay of a radioactive substance. This is the model for the first stage of research.

The second stage concerns the application of discovered facts through invention. Here again, the rate of progress is proportional to the amount of effort expended and to the size of the pool of knowledge—in this case, the number of discovered but unapplied facts. Yet a fact may be applied many times, in different combinations with other facts. It is not the unit of knowledge that is important—rather, it is the conclusions drawn from a number of units. Thus, to determine properly a rate for the second stage, one must invoke the techniques of modern algebra that deal with permutations and combinations of units.

From Discovery to Application. There is, moreover, the question of the time lag between discovery and application. For the second stage, as well as the first, one can draw an analogy with the process of radioactive decay. A mass of radium has a well-defined "half-life" —the amount of time required for half of it to decay—but the time before any individual atom will decay is totally unpredictable. Similarly, the body of known but unapplied facts is considered, on this model, to have a well-defined half-life (in any one field of technical endeavor), but the expected half-life itself is a variable quantity which depends on the amount of effort expended on development work.

By putting these various factors together, one obtains for the second stage an S-shaped curve indicating, first, a slow rate of application, then a more rapid increase, and finally a plateau; curves of this type are familiar to economists for describing the development of a market or a new product. This is the model for the inventive process, and it is confirmed by observation.

Optimum Ratio of Basic and Applied Research. Perhaps the most interesting feature of the model is that one can derive an optimum ratio for the effort to be applied to the two stages of discovery and application of knowledge. The model suggests that, to develop one large and complex field, basic research should not fall below about 20 per cent of the total research budget.

The ratio varies according to the relative ease of doing basic research and applied research—and the "ease factor" may be different in different fields of endeavor. There are other questions: How is the discovery rate affected when only part-time research effort is available? How does one measure the rate of discovery if a field cannot be well defined? Are we anywhere near depleting the pool of knowledge in any one field?

The work involved in preparing the R & D model is in its early stages, and results are highly tentative, but there has been fair agreement between theory and fact.

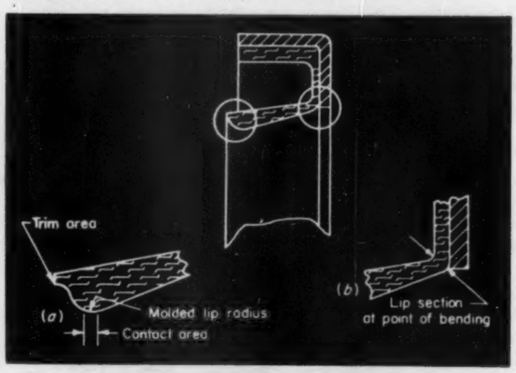
Wiping Seal Design

Applications of needle bearings with wiping contact seals have been restricted by shaft speed. Satisfactory performance has been limited to shaft speeds of 1000 fpm, or approximately 4000 rpm for a 1-in-diam shaft.

According to an article by Richard Smith, chief engineer, Bearing Division, McGill Manufacturing Company, Inc., Valparaiso, Ind., in the Dec. 10, 1959, issue of *Machine Design*, a new seal design is described which increases the maximum speeds of these bearings. The result is a seal which permits shaft speeds as high as 3000 fpm, or 12,000 rpm for a 1-in-diam shaft.

Lubricating efficiency and operating temperatures tend to be more critical in needle bearings than in roller or ball bearings. Temperature rises due to seal friction should be held as low as possible. This condition is met if a seal has correct (*a*) rubber compound, (*b*) lip hardness, (*c*) lip design, (*d*) seal-tolerance control.

Lip-type wiping-contact needle-bearing seal for high-speed operation has small contact area (a) and a thin juncture with the metal seal case (b)



Temperatures over 225 F generally are detrimental to the life of seals because of the curing effect of heat on synthetic rubber. These rubbers tend to harden, or cure as the lip embrittles. High-speed seal durometer hardness should be in the range of 80 to 90 for best performance. Lip design is most critical in high-speed seals. Five design considerations should be met: (*a*) Lip area at the point of contact should be as small as possible; (*b*) contact diameter should be uniform and under as light a tension as consistent with contamination resistance and tolerance limitations of both seal and shaft; (*c*) the lip juncture with the metal seal case should be as thin as possible for minimum resistance to bending; (*d*) diameter at contact should be molded to size, rather than trimmed; (*e*) lip runout with the shaft should be at a minimum.

If these considerations are met, temperatures from 175 to 200 F can be held with bonded or unbonded wiping seals and provide a successful resistance to grease leakage. Most Buna-N synthetic-rubber compounds operate satisfactorily. Where leakage is a problem, grease dams can be molded on the interior portion of the lip. These divert the lubricant from the lip contact and prevent excessive leakage.

Vacuum-Drive Tape

A new high-speed magnetic-tape transport for electronic-data-processing systems is expected to greatly increase the life expectancy of magnetic tapes. It was demonstrated recently by Datamatic Division of Minneapolis-Honeywell Regulator Company and uses an all-vacuum drive (clutch) as well as vacuum to hold the tape reel on its hub, and the tape on the reel.

Engagement commences at the centerline of the tape, minimizing skew, and air lubrication of the tape prevents dirt embossing.

The tape transport drives the tape at 120 ips in either direction and rewinding can be done at 360 ips. It reads or records information at the rate of 96,000 decimal digits (numerals) or 64,000 alphanumeric characters per second. The system has almost instantaneous response to start and stop commands. It commences to move, on receipt of a command, in slightly less than one millisec, and in 2.7 millisec is traveling at full speed. The tape moves substantially less than 0.3 in. on deceleration before it comes to a complete stop. The compactly built unit stands only 5 ft 9 in. high and occupies a floor area slightly over 2 sq ft.

Several of these units may be used simultaneously to supply or receive information at tremendously high rate necessary to keep the central computer of a system busy.

Orthotronic Control, an exclusive Honeywell system for automatically detecting and correcting errors in electronic data processing, was also demonstrated at the same press preview.

The tape mechanism and Orthotronic Control will be standard on the new Honeywell 800 high-speed data-processing systems now being readied at two Boston-area plants for commercial production and delivery to customers beginning in October, 1960.

All-vacuum drive virtually eliminates damage to magnetic tapes and substantially increases the efficiency of handling and the life expectancy

What Size Access?

"Unless you are putting a box around a group of components that are 100 per cent reliable—and very few components are," states Joseph L. Seminara, human-factors specialist of Saratoga, Calif., in the December 7, 1959, issue of *Product Engineering*, "you've got to provide some way to get at the innards."

The article develops a number of minimum standards for the size of access openings, based on measurements made from a large group of Air Force personnel. The author emphasizes that it does no good for the designer to measure his own hand—if hand access is required—or even to take an average hand measurement. Access should be large enough to accommodate at least 95 per cent of potential users. On the other hand, if the opening is larger than necessary, it may weaken the structure.

Other important considerations are the physical characteristics of objects to be removed and replaced through the hole and the movements required of the operator such as turning, pulling, and pushing.

Specific recommendations made: (*a*) Doors should be easily removable; (*b*) avoid sharp edges; (*c*) hinged doors should fold back to prevent obstruction; (*d*) round or oval openings give greatest usable space per unit area; (*e*) place openings, wherever possible, at working height —4 to 5 ft above ground for standing, 2 to 3 ft for sitting, 3 to 4 ft for kneeling; (*d*) allow extra space or window where visibility is desirable; (*g*) provide illumination if service lamp or available light isn't enough; (*h*) provide safety locks, attention-getting labels, and adequate instructions where high voltage or other hazards exist.

Some representative dimensions: (*a*) Access for empty hand—2.25 × 4 or 3.5 × 3.5 in.; (*b*) for head, 9.3 in. diam; (*c*) manhole, 22.8 in. diam; (*d*) crawl space, 19.1 × 34 in.; (*e*) prone access, 22.8 × 16.4 in. high; (*f*) passageway for erect body, 73 in. high, and 13 in. wide for sideways approach, or 22.8 for direct approach; (*g*) recessed pushbutton, 0.93 in. sq; (*h*) access for two-hand tasks—width should be $^3/_4$ of the depth of reach, the height a minimum of 4 in.

Nuclear Briefs

▶ S1C Submarine Prototype Plant Goes Critical

The S1C land-based nuclear-submarine prototype power plant, designed and developed for the United States Atomic Energy Commission by Combustion Engineering, Inc., has achieved full power at the company's Windsor, Conn., plant. A comprehensive evaluation and testing program will be undertaken.

A duplicate of the S1C, also designed by Combustion, is now being installed in the *Tullibee*, the Navy's first nuclear hunter-killer submarine under construction in the yards of the Electric Boat Division of the General Dynamics Corporation in Groton, Conn.

▶ Simple Metal-Differentiating Meter

A unique device sorts different metals that look alike without costly, time-consuming, and complicated testing.

The simple, inexpensive tester, developed at the Knolls Atomic Power Laboratory, can be used without special training. It quickly differentiates between Inconel and stainless steel, zircaloy-2 and zirconium, and zircaloy-2 and hafnium—nonmagnetic metals widely used in components for nuclear reactors that can easily be confused.

The device consists of a standard milliammeter with two leads—one ending in a clamp and the other in a small carbon-steel file. Metals are tested by simply attaching the clamp to a sample and rubbing the file briskly against the metal.

The rubbing of the file causes a local hot spot and the thermoelectric effect generates a tiny current, about 5-10 milliamperes for Inconel or stainless steel, which causes the meter pointer to indicate on a special dial the kind of metal being tested.

▶ British Nuclear Tanker, Other Merchant Ships

The British government has accepted the recommendation of the Galbraith Committee (a government and industry committee formed to examine nuclear-powered shipping) to invite bids from selected firms having "proper resources" for a reactor to be installed in a 60,000-dead-weight-ton tanker, according to the January, 1960, *Forum Memo*, published by the Atomic Industrial Forum, Inc. The bidding will be restricted to reactors of the boiling-water and organic-moderated types.

Other nations with advanced plans for nuclear-powered merchant ships include West Germany—where a group has announced it will convert an existing 15,000-ton tanker to nuclear power by 1962; and Japan—which is now considering the selection of a ship and reactor type for construction by 1964.

▶ SNAP-3 Produces Power for Over A Year

The SNAP-3 nuclear auxiliary power unit unveiled last January at the White House has produced electricity for more than a year, although it was only intended to demonstrate maintenance-free operation over a period of about 140 days.

The output of the unit, made by the Nuclear Division of The Martin Company, has dropped to a fraction of a watt, but the use of radioisotopes which decay more slowly than polonium 210 could prolong operation without any substantial change in size or weight. Other isotopes could also be used to boost the generator's power level.

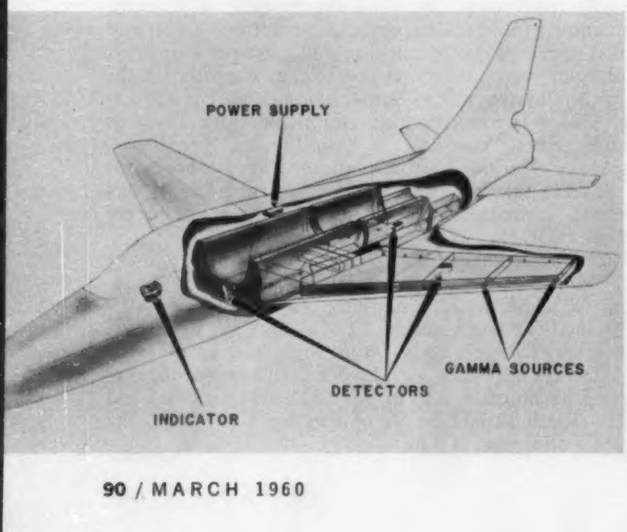
The life of chemical batteries of comparable size is limited to a few weeks, and isotopic power units appear to offer greater reliability than solar cells.

▶ Gamma-Radiation Gasoline Gage

A transistorized gamma-radiation gage which measures the amount of fuel in airplanes and missiles with greater accuracy and reliability than conventional devices has been developed for the U. S. Navy by Atomics International, a division of North American Aviation, Inc.

All types of solid and liquid propellants can be measured by the gage. Performance of the gage is not affected by impurities in the fuel. It measures all the fuel, is easily installed, and automatically accounts for differences in hydrocarbon or petroleum-based fuels which affect the accuracy of conventional devices used for this purpose.

A cobalt-60 source provides the radiation which is decreased in density as it passes through the fuel. Scintillation detectors containing a ratemeter and pulse amplifier measure the radiation and an indicator records the quantity of fuel in pounds.



A fuel gage unaffected by altitude, cosmic radiation, or attitude of the plane uses cobalt-60 sources at fuel-tank sides. Detector package, **left**, measures gamma-ray intensity and registers the amount of fuel on the plane's instrument panel. Cylinder in model's hand has a radiation source at the tip.

Materials Briefs

▶ Higher States of Matter

The state of matter—solid, liquid, or gaseous—is defined by the degree of freedom with which its thermodynamic equation of state must contend. With the widespread application of plasma research it has become commonplace to talk of plasma—an electrically neutral mixture of ions and electrons—as the fourth state of matter because the electron-ion separation introduces a new degree of freedom. Two scientists, D. Finkelstein and P. A. Surrock at CERN, the European Organization for Nuclear Research in Switzerland, speculate on even higher states, according to the October 30, 1959, issue of *Engineering*.

A nuclear plasma composed of free neutrons and protons in space would be a fifth state in which the intranuclear degrees of freedom are excited. Finally, the liberation of the internal degrees of freedom in the subatomic particles—in pair production or meson production, for instance—would lead to a sixth state of matter which might be called elementary particle plasma. At the moment no higher states can be imagined although continued high-energy research may lead to the discovery of further differentiation in elementary particles.

Turning to speculation on the relative abundance of various states of matter: On earth, higher states are found only in minute quantities and only for brief periods of time. The fourth state—ionized gases—exists in fluorescent tubes and in the path of ionizing radiation, but the fifth and sixth states occur only in nuclear explosions and high-energy laboratories. Outside the earth the balance changes and indications are that the higher states predominate. The Van Allen belt of radiation, the luminous stars, cosmic rays, in fact most of the universe, probably consists of higher states of matter.

▶ Alumina Potting Compounds

Alumina powder (aluminum oxide) has been used successfully to insulate or "pot" transformers and other electrical components within hermetically sealed cans at Bell Telephone Laboratories. The basically new approach to the protection of electric components replaces the more conventional semifluid materials such as mineral-filled asphalts.

These potting compounds serve as a heat-transfer material to carry the heat from the device to the can, and thence to the air, in order to reduce the over-all temperature rise. Unfortunately, most of them melt at the relatively low temperature of 275 to 300 F, expanding and threatening the hermetic seal and often damaging the component.

Alumina powder's melting point is over 2700 F, well above the operating temperatures of any electrical apparatus. It furnishes a single potting compound which can be used over the entire gamut of temperature ranges. It does not expand or contract to any noticeable extent under wide fluctuations of temperature, so no strains are imposed on the component. Also, no curing or vulcanizing is required as with some of the plastic potting compounds, and the strains which develop from these processes are eliminated.

The powder also maintains its dry, granular form in use, permitting the electrical component to be removed for inspection or repairs at will simply by breaking the seal on the can and pouring out the powder. Since alumina is completely inert, there is no fire hazard. In the preferred spherical physical form which is readily available at prices competitive with conventional materials, the granules pack well but do not have the abrasive characteristics of more irregular shapes.

The test program on alumina potting compounds was performed on typical, medium-sized electronic power transformers, which were impregnated with a polymerizing varnish before the potting and encasing were undertaken.

▶ Polycarbonate-Resin Thermoplastic Material

Commercial quantities of Merlon, Mobay Chemical Company's polycarbonate resin, will be available this spring at a full-scale production facility nearing completion at the company's New Martinsville, W. Va., manufacturing plant.

Manufacturers of components for the electrical, electronic, automotive, safety equipment, data computer, and other industries have shown high interest in the properties of polycarbonate resin. Pilot-plant quantities have been available to them during the past year for development studies.

In addition to exceptionally high impact resistance, dimensional stability, and greater resistance to heat, moisture, and weathering than most other thermoplastics polycarbonate offers a number of production advantages. It can be processed by any of the conventional thermoplastic methods, including injection molding, extrusion, vacuum molding, and others. No plasticizers are required.

▶ Transaxle Lubricant

More than 40 fluids have been evaluated by General Motors Research Laboratories for the simultaneous lubrication needs of both hypoid gears in the axle and clutch plates in the single transaxle transmissions being used in newer cars.

Simple blends of hypoid-gear lubes and automatic-transmission fluids do not produce compatible operation of both transaxle elements.

The results, reported at a Society of Automotive Engineers meeting, indicated that three mineral-oil-base fluids and one synthetic-base fluid merited further investigation.

Powdered aluminum oxide replaces mineral-filled asphalts as a potting compound for electrical components. It has better properties and is simply poured in or out of the container.

PHOTO BRIEFS

1 Cone of Steel. This ring of $1/2$-in-thick steel plate being welded at R. C. Mahon Company, Detroit, Mich., will form part of the gas and radiation sealing system of the Enrico Fermi plant at Monroe, Mich. It flares out from 18 to 20 ft in diam, with wall height of 5 ft, to conform with the shape of the containment vessel, or primary shielding of the reactor. Clamping and fixturing are critical because of close tolerances.

2 Big Blender. The Patterson Kelley Company of East Stroudsburg, Pa., built this huge blender capable of blending enough plastic powder to fill two railroad hopper cars. Said to be the world's largest, the 30-ton blender has a working capacity of 1700 cu ft. It consists of two cylinders, of $1/2$-in. stainless steel, cut at right angles and joined to form a V design. For shipping, it had to be cut in half just below the axis (where alignment is not affected) and, on arrival, rewelded. Rotation: 4 rpm.

3 Exploration. Here is the most advanced of several devices used at Battelle Memorial Institute's Structural Chemistry Division in research for the Atomic Energy Commission. Purpose: To investigate hitherto unexplored effects of heat and pressure on materials. When the die closes on a specimen, pressures are generated in excess of 1,000,000 psi—and temperatures above 3600 F. The combination simulates conditions for the formation of minerals and gems in the earth, approximating a depth of 200 miles, where diamonds are believed to have their origin.

4 Please Pass the Steel. This manipulator can do it. It's a combination coil lifting and tilting mechanism for use in steel, aluminum, and brass mills—and warehouses—developed by American Forge and Manufacturing Company, McKees Rocks, Pa. Because of the reduced number of handlings (it eliminates lifting tongs, floor-mounted tilting devices, "C" hooks) there are savings in handling time, and less chance of coil damage. The manipulator handles coils ranging from 5000 to 30,000 lb and is operated either from the crane cab or from pendant controls.

5 Marine Fender. Another "world's largest," this giant rubber tube, developed by Goodyear, soaks up nearly 300,000 lb of load pressure per ft. The fender is 21 in. OD, and $10\frac{1}{2}$ in. ID. A one-foot section weighs 135 lb and will absorb 45,700 ft lb of kinetic energy. It has a superior load-energy absorption ratio: For every ft-lb of energy absorbed, a load of only 2.25 lb is transmitted to the dock or pier. It will mean lighter ship-docking structures, at lower costs.

6 Rivets Must Be Right. Engineers of Boeing's Transport Division developed this electronic rivet-head inspection device which provides increased accuracy and reduces inspection time by two thirds over former hand-gaging methods. It indicates, to the ten-thousandth of an inch, any deviation from standard. The new device will check a batch of 50 rivets and come up with a figure, automatically averaged and computed, governing acceptance or rejection.

Windows in the Sky. Polished high-temperature viewports, by Corning Glass, for the first manned space capsule, by McDonnell Aircraft. Four panes thick, the picture windows will withstand the heat and shock of re-entry.

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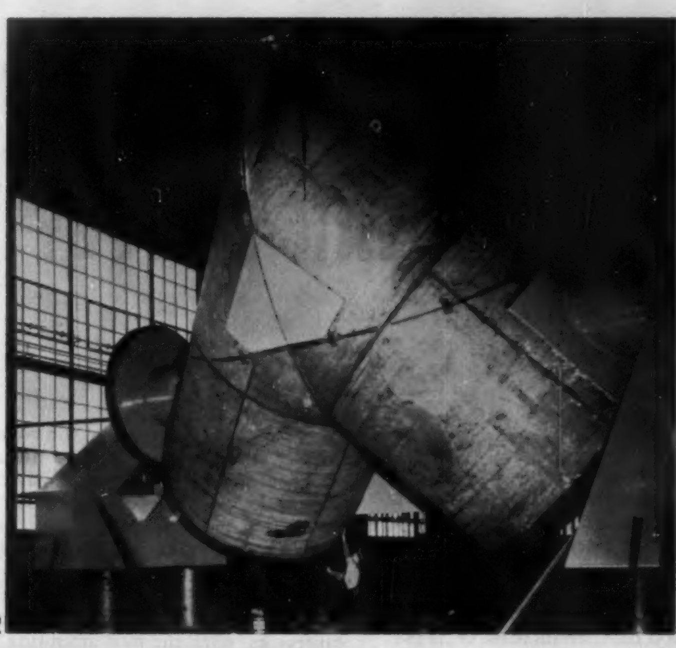

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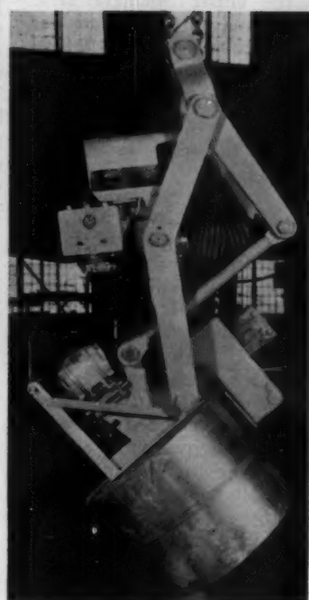


6

Engineering Progress in the British Isles and Western Europe

EUROPEAN SURVEY

J. FOSTER PETREE
European Correspondent

Electric Arc Furnaces

IN THE "European Survey" published in MECHANICAL ENGINEERING for May, 1956, there was described a major reconstruction of the Templeborough steel melting shop of Steel, Peech & Tozer, Ltd., of Sheffield, England, in which, without interrupting production, 14 open-hearth furnaces of 80 tons capacity each were rebuilt in sequence to produce 100 tons each, raising the annual output of the shop to more than 800,000 tons, an increase of 35 per cent. The firm has now decided to strip out the whole of this plant, together with the seven open-hearth furnaces at their Rotherham steelworks, and to replace it by six electric arc furnaces of 110 tons capacity each.

When the conversion is completed in five years' time, the firm will have at Templeborough the largest electric steelmaking plant in the world, with an annual capacity of 1,350,000 ingot tons of steel. Initially, four furnaces of the swing-roof type will be installed; they expect to have the first of these in commission by January, 1963. The power demand of the new plant will be 750 million units a year, which is six times the amount used at present by the whole steelworks and more than a third of the existing industrial load in the entire Sheffield area. Current will be taken from the national supergrid at 275,000 volts to a new transformer station, which will supply at 33,000 volts to the melting shop, where it will be transformed down again to 565/200 volts for the furnaces.

Air Testing of Atomic Piles

THE Belgian atomic research establishment at Mol, for the production of radioisotopes, has two atomic piles, the BR2 and BR3, which are encased in protective steel envelopes, one with a volume of about 230,000 cu ft and the other of more than 1,000,000 cu ft. It was required to test these by internal pressure to insure that they were completely leakproof, the prescribed pressures being 17 psi for the larger tower and 64 psi for the smaller. Obviously, hydraulic tests were out of the question, in view of the size of the structures, and it was decided to use air in conjunction with ultrasensitive microphones to trace any leaks. It was essential that the air used should be absolutely dry. The plant used comprised two Atlas Copco type 575Id portable compressors made by the Atlas Copco Company, Stockholm, Sweden, each delivering 575 cfm of air, to develop the initial pressure, and a smaller compressor of the same Swedish make, a type VT4.Dd, with an output of 160 cfm, to maintain the pressure during the test. Two coolers were inserted in the air circuit, and two more were used as scrubbers to keep the air dry. For 18 hr the compressor inlets were connected in closed circuit to the atmosphere in the steel envelopes, with one-way valves behind the final coolers to keep up the pressure to 99.5 psi while the condensation water separated out. The inlets were then disconnected from the envelopes and the pressure brought up to test level. To guard against any risk of explosion, the area round the towers was evacuated during the tests, which were controlled from a concrete shelter, and the compressors, with the men attending to them, were protected by a wall of sandbags.

Cutting-Oil Mist Sprayer

HIGH-SPEED lathe work and other machining, which would be best done with the use of a coolant, must often be carried out dry because it is not practicable to cover the work with splash guards. To meet such conditions, Wakefield-Dick Industrial Oils, Ltd., of Castrol House, Marylebone Road, London, England, have developed a device for enabling cutting oils to be applied to the work face in the form of a mist, delivered in a stream of compressed air. It consists of a porous bronze filter, a pressure reducing valve with a gage to indicate the reduced air pressure, and a lubricator provided with a flow adjustment by means of a needle valve. A regulating screw on top of the lubricator controls the oil/air ratio. The lubricator has a transparent oil reservoir, which can be supplied to hold either 1/2 or 1 pint. The unit operates at a pressure of 10 to 20 psi, according to requirements, and is suitable for use with neat cutting oils of a viscosity not exceeding 300 Redwood (354 Saybolt) at 70 F or with soluble oil emulsions.

Steel tower protecting an atomic pile at the nuclear plant, Mol, Belgium, is tested for leakage by internal air pressure

Cargo will be handled on the liner, **Canberra**, under construction, by a "cargo transporter" that will load and discharge through the ship's side

Transporting Liquid Methane

The delivery of the Thomas Lowe Gray Lecture is one of the main annual events in the program of The Institution of Mechanical Engineers at its headquarters in London, England. This year's lecture, delivered on January 27, was exceptional in that it was given by an American, Dr. John J. McMullen, Mem. ASME, president of the Hudson Engineering Company, Hoboken, N. J., and previously Chief of the Office of Ship Construction and Repair in the U. S. Maritime Administration, Department of Commerce, who took as his subject, "Technical and Economic Aspects Covering the Ocean Transportation of Liquid Methane." This is a matter of much interest already in London, where imported liquid methane is now being used to supplement the supplies of gas made from coal and, to some extent, from oil. Dr. McMullen gave figures for the increasing consumption of natural gas and for the enormous reserves already known, which surprised his British audience, and clearly indicated the opinion that, as progress continued to be made in tapping the resources of, especially, Venezuela, the Middle East, and North Africa, there was likely to be a considerable expansion in the transport of liquefied gas by sea. He urged, therefore, that the necessary preliminary research and development work on tankers to carry it should be taken in hand at once, and that the shipping industry, "traditionally lethargic and conservative," should not be caught unprepared when the demand came.

Transatlantic Liner "France"

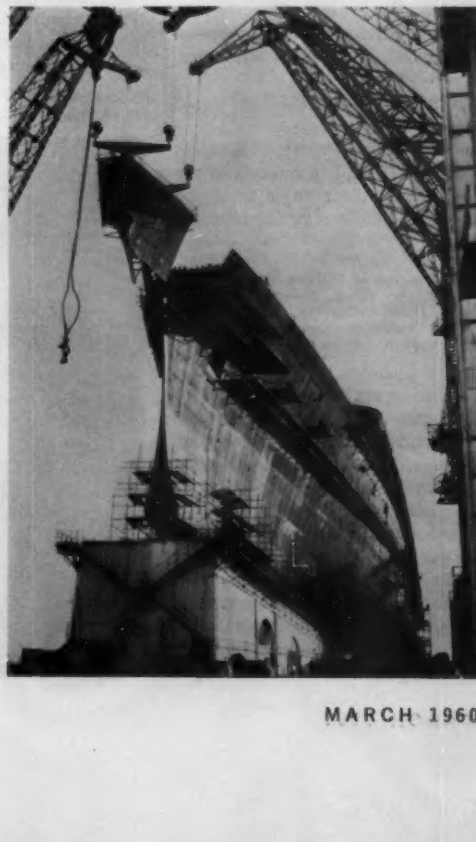
The French Line's transatlantic liner *France*, which was ordered in 1957 as a replacement for the ill-fated *Normandie*, is now well advanced toward the launching stage. She is being built in the yard of the Chantiers de l'Atlantique at Saint Nazaire and will be the longest liner in the world, with an over-all length of 1035 ft. The launching weight is expected to be about 35,000 tons—also a record. She will be propelled by geared turbine machinery of 160,000 shp, giving a speed of 31 knots, and taking steam from eight boilers with a working pressure of 65 kgm per sq cm (about 900 psi) and a steam temperature of 480 C (896 F). The machinery weight, at 8000 tons, will be 3000 tons less than that of the *Normandie*, which was of the same power, and the designed fuel consumption will be 40 per cent less. Launching is scheduled for May 11, 1960.

"Canberra" Cargo Transporter

Another large liner, which will go into service in 1961, is the *Canberra*, being built at the Harland & Wolff shipyard at Belfast, Northern Ireland, for the Australian route jointly operated by her owners, the Peninsular & Oriental Steam Navigation Company and their associates, the Orient Line. In this ship there will be no masts and derricks for cargo handling. Instead, a "cargo transporter" will be fitted to load and discharge through the ship's side. It is of the type developed by the Lake Shore Company of Iron Mountain, Mich., and has been constructed under their license by Carron Company, of Carron, Falkirk, Scotland. It consists of a thwartship boom which can be run out through openings in either side of the ship. On the boom is a traveling carriage containing the hoisting and traversing gear, which is under the control of one man sitting in a cab under the carriage. From the carriage is suspended a platform which, when hoisted to the limit, is locked in position by the engagement of rigid steel stays, attached to the carriage, with taper sockets on each side of the platform; thus there is no risk of the platform swinging while it is being traversed overside from the ship. The length of the boom is such that, when it is run out to the full extent over the quay, the inner end is over the ship's hatch. Thus goods can be hoisted straight out of the hold, run out to the end of the boom, and lowered onto the quay. The *Canberra* will rely entirely on this method of cargo handling, no derricks being fitted; in fact, she has no derrick posts, and the only mast is that on the superstructure, for signaling purposes.

Correspondence with Mr. Petree should be addressed to 36 Mayfield Road, Sutton, Surrey, England.

The French Line's transatlantic liner, **France**, reaches final stages of construction



Substance in Brief of Papers Presented at ASME Meetings

M. ZANFARDINO
Staff Editor

ASME TECHNICAL DIGEST

Production Engineering

The Deformation Process in Metal-Cutting..59—A-165...By W. J. McDonald and B. F. Murphey, Minnesota Mining and Manufacturing Company, St. Paul, Minn. 1959 ASME Annual Meeting paper (in type; to be published in Trans. ASME—J. Engng. for Indus.; available to Oct. 1, 1960).

An analysis of the orthogonal chip process for a strain-hardening material is presented together with a qualitative evaluation of the effects of temperature increases and of flank rubbing.

An expression is derived for the average stress on planes through the tool point ahead of the shear plane.

The authors postulate that the strain-hardening requires that a stress-reinforcing phenomenon be present and that this requires the shear to take place in a region of increasing stress.

The rate of increase required is postulated to depend on the final strain imparted to the chip.

Data from the literature are presented to support this view.

The conclusion is drawn that the strain imparted to the chip is a measure of the deviation of the shear angle from the Merchant minimum-energy condition.

Design Concept of Welded-Steel Lathe.. 59—A-272...By G. M. Sommer, Clearing Division, U. S. Industries, Inc., Chicago, Ill. 1959 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1960).

Engine lathes are truly basic machine tools. In this day of special purpose, high-production-rate machines, the engine lathe is still in great demand because of its extreme versatility, ease of operation, and competitive cost.

The author's company began production of a radically advanced lathe line in 1958. The new design incorporates all basic driving mechanisms in one integral unit. Combining all drive units into one structure means that the headstock is self-supporting and not perched on top of the bed. This makes a much more rigid structure, simplifies design, eliminates oil-sealing problems, and makes good styling easy and straightforward.

This paper gives the preliminary machine specifications and design concept for the newly developed engine lathe. The use of modular units and welded construction to achieve maximum performance is discussed. Comparative rigidity and vibration resonance data between the new welded-steel bed and conventional cast-iron beds is also given.

Some Problems of Press Forging Lead and Aluminum..59—A-164...By A. G. MacDonald, S. Kobayashi, and E. G. Thomsen, Mem. ASME, University of California, Berkeley, Calif. 1959 ASME Annual Meeting paper (in type; to be published in Trans. ASME—J. Engng. for Indus.; available to Oct. 1, 1960).

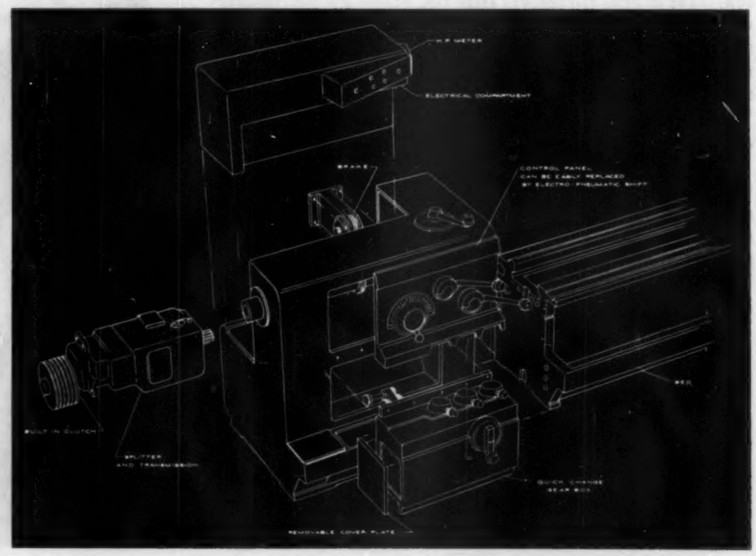
Several press forgings were made and it was found that the experimental mean forging pressures were in substantial agreement with values predicted by theoretical solutions based on an approximate theory.

The forging processes were axial symmetric forging of disks between flat dies and forging in closed dies with several edge effects, such as overhanging flash, with and without flash-edge restriction. The materials were commercially pure aluminum and lead and were chosen because of their respective work-hardening and strain-rate effects at room temperature.

It was found further that the local pressures measured in the forging were in good agreement with the theory, but that some local plastic flow tends to equalize the pressure in the body of the forging.

Drawability of Sheet Aluminum Alloy 5457..59—A-310...By R. W. Bund, General Motors Institute, Flint, Mich. 1959 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1960).

Sketch of modular units which comprise headstock of newly developed 20-in. heavy-duty lathe (59—A-272)



Drawability of sheet metal is a subject not yet understood. Production engineers continue to hunt for a good way to segregate sheet-metal stock so that the more difficult parts can be manufactured from those heats of metal having better drawability. These productions engineers would like a simple test to grade sheet metal for drawability.

The objective of this paper is to present the experimental results of tensile testing aluminum alloy 5457 in the plastic range and to show how these results can be used when processing this alloy for sheet-metal-drawing operations. This alloy is widely used for automotive sheet-metal applications because of its relatively low cost combined with its ability to be anodized.

Strain-hardening curves for aluminum alloy 5457 are presented as developed from cylindrical tensile-test specimens and sheet-metal tensile-test specimens. Use of this information when processing for sheet metal-drawing operations is discussed.

Microanalysis of Steel-Rule Cutting..59—A-285...By D. F. Eary, General Motors Institute, Flint, Mich. 1959 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1960).

Steel-rule cutting of blanks from sheet metal has become a popular process for low production rates.

Microphotographs taken of successively deeper penetrations of the steel rule into sheet metal reveal certain characteristics.

The theory that the steel rule deflects to create the correct clearance for the sheet-metal thickness is verified.

The sharpness of the steel-rule cutting edge shows why a very small burr occurs.

The penetration required is greater than for conventional dies.

The fracture from the punch occurs first as in conventional dies.

Analysis of Power Spinning Cones..59—A-173...By B. Avitzur, Assoc. Mem. ASME, Ford Motor Company, Dearborn, Mich.; and C. T. Yang, University of Michigan, Ann Arbor, Mich. 1959 ASME Annual Meeting paper (in type; to be published in Trans. ASME—J. Engng. for Indus.; available to Oct. 1, 1960).

The geometry of the cone, the roller, and the spinning operation are described mathematically. A shear type of deformation is postulated, based on experimental evidence.

The displacement, velocity, strain rate, and stress fields are computed for "Mises' material," and hence with Mises' stress-strain rate law.

The power consumed in the operation is computed from the strain rate and stress fields.

The expression for the power is in a form that can scarcely be solved analytically. A numerical solution is therefore employed and results are presented in graphical forms, where the power and tangential force are plotted for a variety of the process variables. The numerical solution is compared with actual power and force measurement in experimental tests and the agreement is reasonably good.

Facilities for Handling and Welding Assemblies in the Machinery Industry..59—A-296...By John Mikulak, Worthington Corporation, Harrison, N. J. 1959 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1960).

Automation of manufacturing operations is increasing the capitalization cost and providing a higher indirect expense so that it is necessary to provide functional designs where the various components can be handled easily and where handling is kept to a minimum.

For this reason, where possible, all welding should be performed in a practical manner from one side of the assembly and all machining performed with one setup and preferably on one machine tool. Further, employing transfer tooling on the machine-tool equipment provides the cutting tools an opportunity for the spindle to perform at high efficiency. It is important to state that design is the basic criterion to afford the production shop an opportunity to provide an efficient manufacturing operation.

By means of numerous examples of the current types of handling equipment in fabricating and welding shops, this paper demonstrates available types of positioners and manipulators being used to speed up production of heavy equipment.

Management

The Administration of Research and Development Projects..59—A-246...By H. L. Mills, Assoc. Mem. ASME, Flight Propulsion Division, General Electric Company, Evendale, Ohio. 1959 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1960).

Much of the apprehension with which general management regards research can be traced to the attitude of numbers of technically creative people who feel that creativity can neither be measured nor controlled. No organization which is in business to make a profit can sanction such an attitude. Research and development activities can be controlled, and in fact must be, if a company is to apply its resources effectively.

To overcome the first hurdle we must begin by considering R & D a bona fide segment of the business, with inputs of men, money, and machines, and with definite expected outputs. Usually, a company can expect its engineering function to develop new products, improve the existing models, and provide methods and processes to permit continually more efficient procurement, production, sale, and distribution. Beginning with the concepts of input and output, we need only to determine how to plan and measure these quantities to have the basis for managerial control.

The key to effective control of engineering projects is the systematic application of long-accepted management philosophies.

Methods have been adapted to research and development's unique needs for flexibility, which have permitted closer co-ordination between engineering goals and the long and short-term objectives of a company. The methods described in the paper are essentially a special application of time-proved management concepts. Program authorization, measurement report, and accounting's program report are tools, based on the management cycle and shaped to suit the organization, which permit straightforward planning, operation, measurement, and analysis.

Every effort is made to minimize the restrictions this system imposes upon the practice of research and development engineering. But, while such demands are time-consuming, engineering management, along with the programming staff must provide the force to bring the cycle to life.

Utilizing Industrial Engineering in Engineering Management..59—A-244...By J. L. Rigassion, Assoc. Mem. ASME, Newark College of Engineering, Newark, N. J. 1959 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1960).

The dynamic growth of engineering technology has directed management's attention to the broader utilization of industrial engineering in engineering and engineering management functions.

The industrial engineer, through contribution of mathematical, empirical, procedural, and accounting skills offers the engineering manager specialized assistance to: (*a*) Improve utilization of engineering personnel through specialization of effort; (*b*) provide project supervisors with support in co-ordination efforts; (*c*) effect quicker and more complete integration of production, methods, standards, and cost operations in engineering developments; and (*d*) provide opportunity for on-the-job training in both supervisory and engineering techniques. Recent work by groups of professional engineers to establish a prac-

tical definition of their work should promote the wide application of industrial engineering which has already begun in the higher diversified organizational placement of industrial engineering staff in many of the more progressive companies.

Modernized Engineering Organization..59—A-245...By C. E. Paules, Esso Research and Engineering Company, Linden, N. J. 1959 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1960).

An engineering organization should be tailored to the particular work requirements of the department.

It cannot be static but should be subject to long-range study with necessary interim changes made in conformity with the long-range objective.

Major operating problems are discussed; these include in part, need for good working conditions, development of replacements for supervisory and key technical positions, contacts with others, cost consciousness both with respect to departmental cost and improvement of construction and operating costs, utilization of new techniques or engineering tools, and keeping abreast of developments through technical society participation, literature, and so on.

Academic Preparation for Engineers in Management..59—A-248...By O. S. Carliss, Mem. ASME, The Yale and Towne Manufacturing Company, Philadelphia, Pa. 1960 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1960).

The author believes that the curriculum and environment of today's engineering school provides the best training for a career in management, particularly for the management of a technological enterprise, but serving equally well for the management of any type of operation since the principles and disciplines of management transcend the peculiarities of a particular organization.

Primarily, an education should be concerned with man's powers of judgment and decision, so that he may apply himself thoughtfully and responsibly to his own and to the world's work.

Hydraulics

Charts for Determining Size of Surge Suppressors for Pump-Discharge Lines..59—A-73...By C. W. Lundgren, Bureau of Reclamation, U. S. Department of the Interior, Denver, Colo. 1959 ASME Annual Meeting paper (in type; to be published in **Trans. ASME—J. Basic Engng.**; available to Oct. 1, 1960).

A typical surge suppressor consists of a pilot-operated valve which opens quickly after a power interruption through loss of power to a solenoid, or by a sudden pressure reduction at the surge suppressor, thereby providing an open valve for releasing the reversed flow of water. The valve is subsequently closed at a slow rate by the action of a dash pot to control the pressure rise.

Surge suppressors are often used for the control of water-hammer pressures which occur in pump-discharge lines subsequent to power interruptions.

This paper includes charts for determining the size of the required suppressors when water-column separations do not occur.

A Review of Surge-Tank Stability Criteria..59—A-270...By Charles Jaeger, English Electric Company, Rugby, England. 1959 ASME Annual Meeting paper (multilithographed; to be published in **Trans. ASME—J. Basic Engng.**; available to Oct. 1, 1960).

Determination of surge-tank stability and the validity of the Thoma formula are matters which are demanding much attention from hydraulic engineers today. The author believes that a useful contribution could now be made toward a better understanding of the problem by a comprehensive review of existing published works, and by further comments on known facts and test results. When Scimemi (Padua) published some critical remarks on the validity of the stability theory of Thoma, it was felt that a review of the whole problem of surges was desirable.

A general discussion was introduced in 1953 at The Institution of Mechanical Engineers, London, which brought forth much additional material in the form of further contributions.

The situation with regard to stability theories today is similar, and a review is desirable of the often widely divergent theories, facts, and opinions concerning surge-tank stability.

Cavitation in Centrifugal Pumps With Liquids Other Than Water..59—A-158...By A. J. Stepanoff, Mem. ASME, Ingersoll-Rand Company, Phillipsburg, N. J. 1959 ASME Annual Meeting paper (in type; to be published in **Trans. ASME—J. Basic Engng.**; available to Oct. 1, 1960).

Conditions leading to cavitation of liquids other than water are examined.

The concept of the thermal cavitation criterion is considered in view of new test data on hot water and other liquids, and its utility for determination of NPSH corrections is demonstrated.

The effect of the suction specific speed on the NPSH corrections is tentatively established.

The following conclusions are established:

1 If cavitation is to be avoided, or kept at the incipient point, all liquids require exactly the same NPSH under the same operating conditions.

2 Under the conditions of limited or controlled cavitation to produce the same cavitation measurable effect reduction of NPSH value below that of cold water is possible for certain liquids if suitable cavitation-resisting materials are used for impellers.

3 The NPSH correction is found from the value of the thermal cavitation criterion, picked out from the available test data plotted against the vapor pressure.

Centrifugal Pumps Used as Hydraulic Turbines..59—A-136...By C. P. Kittredge, Mem. ASME, Princeton University, Princeton, N. J. 1959 ASME Annual Meeting paper (in type; to be published in **Trans. ASME—J. Basic Engng.**; available to Oct. 1, 1960).

Centrifugal pumps may be used to advantage as hydraulic turbines in applications where the required power is rather small and low initial cost is more important than high efficiency.

An estimate of the performance of a centrifugal pump when used as a turbine can be made from published curves of complete characteristics for typical pumps.

The purpose of this paper is to present some of the available data on pumps and to show how to select a pump which will meet specified requirements when used as a turbine.

Calculating Effective Thrust Loads in Axial-Piston Pumps..59—A-307...By N. M. Wickstrand, The Torrington Company, Torrington, Conn. 1959 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1960).

The axial-piston pump is subject to internal unbalanced forces that are disturbingly contradictory to its symmetrical appearance. These unbalanced forces occur primarily because all pistons are not under the same pressure. In spite of the unbalanced forces the loads on all of the bearings except for the upper thrust bearing can be found by simple statics and bearing selection made without any special considerations.

The load on the upper thrust bearing can also be found by statics. However, the load is not applied at the center of the bearing and its direction is not even parallel to the axis of the bearing. This results in a nonuniform load distribution on the rolling elements of the bearing which, if not considered in selecting the bearing size, might result in premature failure.

A method is developed for computing the effect of eccentric loading on thrust bearings, particularly those adjacent to the pistons in an axial-piston pump.

Relief Valves for Mobile Applications.. 59—A-320...By C. A. L. Ruhl, New York Air Brake Company, Kalamazoo Division, Kalamazoo, Mich. 1959 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1960).

Three basic types of relief valve—simple poppet, differential, and pilot operated—have been in existence for some time. Applications of relief valves in the mobile field vary considerably, there being a need for each of the basic types.

In the agricultural field, there are many applications where the relief valve is used only intermittently for short durations on relatively low-volume systems.

For many lift-truck applications, and particularly electric lift trucks, power consumption of the hydraulic system has been of paramount importance. Therefore there has been a need for relief valves that have very low leakage and pressure build-up characteristics.

For the road machinery equipment, and particularly for front-end loaders, the operation during the digging or bucket-loading cycle represents the longest period of the cycle, and in many cases during breakout, considerable flow is diverted over the relief valve.

A recent trend in mobile applications is toward higher pressures—at lower flows the current pressure is 2000 psi.

In addition to relieving the system flow during a working cycle, relief valves have also been used in closed circuits. These applications utilize the relief valve to relieve inertial loads by dumping cylinder fluid to tank. For these closed circuit applications, in the past, a simple poppet type of valve has been considered satisfactory; but the current thinking is that these relief valves should be able to handle considerably more flow without an excessive pressure build up. For newer directional control valves, provisions are made so that these overload relief valves may be incorporated in the directional-control valve housing and are a pilot-operated type of construction.

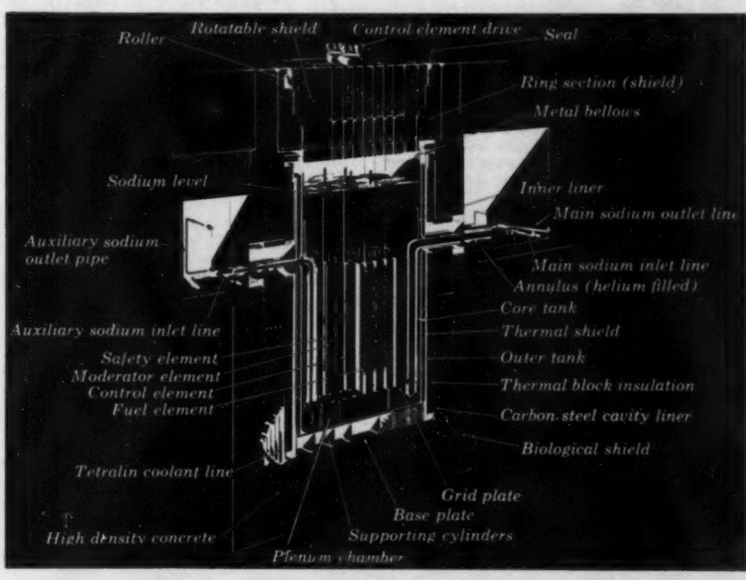
Nuclear Engineering

Operating Experience and Advanced Designs of Sodium-Graphite Reactors..59—A-192...By R. W. Dickinson and L. E. Glasgow, Atomics International, Canoga Park, Calif. 1959 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1960).

The objective of the sodium-graphite reactor program is to produce a nuclear heat source comparable in dynamic performance, reliability, thermal efficiency, and costs to modern fossil-fired plants. A heat source of this type will integrate well into existing electrical networks and maintain its economic value with the more conventional steam stations. The physics engineering and operational information gained from the sodium reactor experiment combined with the detailed economic studies indicate that the objective is attainable in the advanced sodium-graphite reactor design.

Sodium-graphite reactors of advanced design from a mechanical and heat-transfer standpoint, containing improvements in core design and optimized neutron economy, can be expected to produce power in the 5-6 mill power range within 10 years, from plants of 250-emw and larger. These plants will use steam at 2400 psi and 1050 F, and will employ modern reheat and feedwater-heating practices with technology available now. There appears to be no inherent mechanical engineering reason why sodium-cooled, nuclear-reactor plants and, in particular, sodium-graphite reactor plants, cannot be built in any size for which a high-performance turbine system can be constructed. Final development of the advanced epithermal thorium reactor concept will embody the foregoing features, with the additional feature of independence from enriched-fuel requirements after the initial core loading.

Cross-sectional view of general core arrangement of sodium reactor, experiment reactor, and components (59—A-192)



Boiling-Water-Reactor Study..59—A-298...By W. A. Hartman, General Electric Company, San Jose, Calif.; and L. F. C. Reichle, Ebasco Services, Inc., New York, N. Y. 1959 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1960).

A conceptual design and estimated performance characteristics of a boiling-water-reactor type of nuclear power plant for start of construction in July, 1960, is presented.

Work reported is based largely on a study conducted for the U. S. Atomic Energy Commission.

Objective of the study is to identify and describe the most promising type of boiling-water reactor and associated electrical generating plant consistent with the state of the nuclear art and a schedule calling for start of construction in July, 1960. In addition, a cost-size relationship of this type of nuclear power plant is estimated. A number of studies of the technical parameters involved in selecting the design are covered briefly.

An Advanced Pressurized-Water-Reactor Electric Generating Station..59—A-302...By J. B. Anderson, Mem. ASME, Combustion Engineering, Inc., Windsor, Conn.; and C. T. Chave, Mem. ASME, Stone and Webster Corporation, Boston, Mass. 1959 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1960).

This paper is based on a design evaluation of a pressurized-water nuclear power plant conducted by Stone and Webster Engineering Corporation and Combustion Engineering, Inc., under contract

with the United States Atomic Energy Commission.

The main lines of development leading to economically competitive pressurized-water nuclear power plants include higher thermal efficiency, achieved by raising the average coolant temperature near the saturation temperature, improved core design providing uniform power distribution, uniform fuel burnup and extended reactivity lifetime, economical and safe means to control excess reactivity required for extending core lifetime, and over-all system simplification.

The paper discusses improved core-design concepts, multiregion loading, spiked cores, control of long-life cores, fuel cost, thermal plant efficiency, and self-pressurized reactors. While the paper stresses the pressurized-water reactor, many of the design principles employed can be applied to other types with success.

Another Step in Water-Reactor Plant Technology..59—A-292... By A. R. Jones, Westinghouse Electric Corporation, Pittsburgh, Pa. 1959 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1960).

A study of the technical and economic feasibility of closed-cycle water reactors is reported in this paper. The term, closed cycle, is chosen rather than the more commonly used term, pressurized-water reactor, inasmuch as the older term implies a complete absence of boiling.

As a result of the afore-mentioned study, it was determined that such plants are feasible in ratings up to 400 emw. It was also determined that power costs reduce with increasing size up to the point where the turbine designer changes from a tandem-compound to a cross-compound machine. This occurs at a turbine-generator rating of about 360 mw.

The paper continues to report a reference design at this rating.

A single reactor with five heat-transfer loops feeding a single tandem-compound generator is utilized.

Detailed technical and economic analyses have been carried out and the paper reports results of these analyses.

Heavy-Water-Moderated Nuclear Power Plants..59—A-185... By M. S. Silberstein, Assoc. Mem. ASME, J. De Felice, and W. A. Loeb, Nuclear Development Corporation of America, White Plains, N. Y.; and W. A. Chittenden, Assoc. Mem. ASME, Sargent and Lundy, Chicago, Ill. 1959 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1960).

Heavy-water-moderated nuclear reactors for generation of power are of special interest because they may be designed to operate on natural uranium fuel. In contrast with enriched reactors, which have received most of the power reactor development attention in this country, natural uranium fueled plants offer certain unique attributes. Among these are the following:

1 Freedom from dependence on government operation of uranium diffusion plants, or, in some areas, from the need to establish diffusion plant capability.

2 Freedom from dependence on spent-fuel reprocessing plants, while still affording economic operation.

3 Freedom from conflict with military requirements for enriched fuel in the event of national emergency; on the contrary, natural uranium power plants would add to plutonium production capabilities.

4 Ability to obtain fuel in an already existing free competitive market.

Apart from these considerations, heavy water reactors are of interest for economic reasons, as they show promise of producing power at competitive rates with enriched reactors.

Studies have been carried out on the relative near-term economic promise of natural-uranium-fueled heavy-water-moderated reactor power plants.

A 200-emw direct-cycle plant using boiling D_2O coolant in a pressure-tube reactor has been recommended, and a 70-emw natural-uranium prototype is described which can be built based on current technology. The factors leading to the selection of this plant are reviewed briefly, and some of the unusual engineering considerations concerning mechanical, thermal, economic, and plant equipment aspects of the design are discussed.

Machine Design

Rocket Motor-Gear Tooth Analysis . . . Hertzian Contact Stresses and Times.. 59—A-256... By E. K. Gatcombe, Mem. ASME, and Roy W. Prowell, Mem. ASME, U. S. Naval Postgraduate School, Monterey, Calif. 1959 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1960).

A rocket motor turbine-pump reduction gear system is analyzed in regard to Hertzian gear-tooth contact stresses and times of contact.

It is found that the Hertzian contact stresses vary from approximately 100,000 to 200,000 psi. The times of contact vary from 3 to 8 microsec.

Some observations regarding the correlation between contact times and gear failures are made.

It is indicated that it may be possible to establish design limitations on the contact times to insure satisfactory gear operation.

Sample calculations for evaluating each of the typical quantities found in the tables are included.

An Analysis of Factors Used for Strength Rating Helical Gears..59—A-121... By E. J. Wellauer, Mem. ASME, The Falk Corporation, Milwaukee, Wis. 1959 ASME Annual Meeting paper (in type; to be published in **Trans. ASME—J. Engng. for Indus.;** available to Oct. 1, 1960).

Factors used to rate the strength of helical-gear teeth by means of the fundamental tooth-strength formula developed by the American Gear Manufacturers Association's Gear Rating Committee are discussed.

The new approach combines different concepts of geometry factors, an improved evaluation of dynamic loads, rational allowable stresses, and risk or reliability considered as a statistical probability.

In addition, the inclusion of the effect of operating error and load-distributing tooth flexibility provides the gear engineer with a more accurate means for helical-gear strength rating.

Bending Strength of Gear Teeth by Cantilever-Plate Theory..59—A-50... By E. J. Wellauer, Mem. ASME, and A. Seireg, The Falk Corporation, Milwaukee, Wis. 1959 ASME Annual Meeting paper (in type; to be published in **Trans. ASME—J. Engng. for Indus.;** available to Oct. 1, 1960).

This paper presents a study of the bending strength of gear teeth based on a cantilever-plate approach.

A semiempirical solution is given for the finite cantilever plate under transverse loads at any location on its surface.

The solution which is based on the principle of superposition and a proposed moment-image method showed good agreement with results from strain-gage investigations on cantilever plates simulating the gear tooth.

The effects of the position of the line load and the variation of load intensity on the stress distribution at the root are discussed.

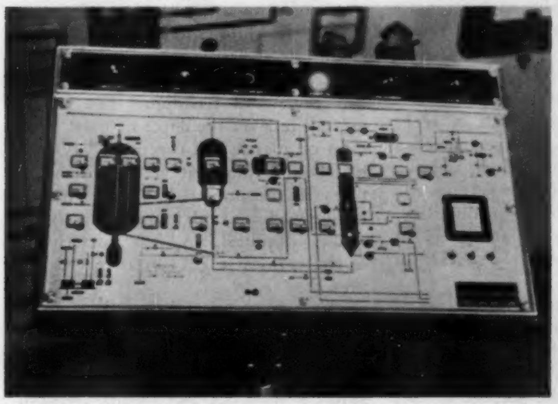
Maintenance and Plant Engineering

Process Simulation Units for Training—2..59—A-205... By F. L. Lichtenfels, Standard Oil Company, Toledo, Ohio. 1959 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1960).

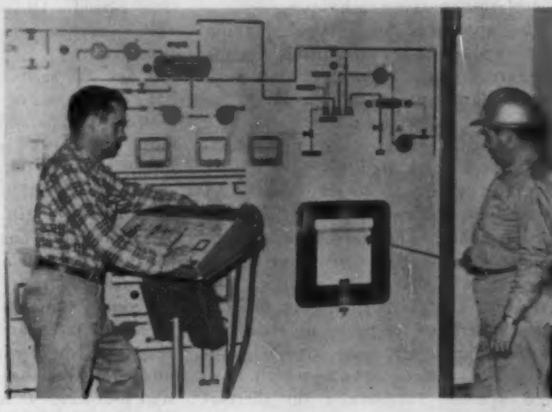
In this companion paper to ASME paper No. 59—A-218 a description is given of experience in the use of process-control simulators to train operators and mechanics at a refinery.

The decision to use a full-scale working

Panel board of central control house of refinery directly controls many processes and all of main streams (59—A-205)



Valuable part of trainer is instructor's console, a miniature of the simulated control panel (59—A-205)



Trainee takes corrective action at controls while instructor observes and adjusts conditions (59—A-205)

model of the refinery's catalytic-cracker board for simulating actual operations was based on the conviction that it would:

1 Give the operators practice in handling variables, starting up the unit, shutting it down, and handling emergencies.

2 Develop the operator's confidence in his ability to handle the controls.

3 Reduce the time necessary to use contractor's operators' assistance in the refinery.

4 Reduce the time necessary to train the operators initially and in the future.

5 Help develop our operators' ability to analyze process problems and take proper corrective action.

The control panel board is described, the training program outlined, and an example of a typical problem is given. The effectiveness of the trainer is noted and additional uses for it are mentioned.

Training on a Process Simulator—1..59—A-218...By E. O. Carmody, Carmody Corporation, Buffalo, N. Y.; and F. L. Lichtenfels, Standard Oil Company of Ohio, Toledo, Ohio. 1959 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1960).

With the increase in complexity of process plants, the training of process technicians, mechanics, and operators, is becoming increasingly lengthy and expensive. One approach to the problem is through the development and application of process-control trainers. These trainers simulate process variable conditions associated with the operation of the plant or unit, and have been used successfully to reduce training time and costs.

The technique involves: (*a*) Placing the operator in a training situation which physically duplicates the operational situation in which he works; (*b*) activating the instruments and controls by which he conducts his work; and (*c*) setting up on the equipment normal and emergency situations likely to arise in his work in order that he might respond and perform as he would on the job.

This paper describes applications of the process-control trainers in the chemical and petroleum industries. A companion paper, ASME paper No. 59—A-205, describes certain of the training techniques.

Metals Engineering

Plasma Flame-Spraying Equipment Development..59—A-236...By R. M. Nadler, Metallizing Engineering Company, Inc., Westbury, L. I., N. Y. 1959 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1960).

Present methods of applying high-temperature materials such as sintering, depositing from a slurry, or slip casting leave much to be desired with regard to material, temperature, and structural limitations.

A new method of applying high-temperature materials to various surfaces is

Operating plasma torch and related equipment. Left to right, d-c motor-generators, spraying hood, operator holding plasma generating torch running at approximately 25-kw power input, control, console, and plasma gas supply. (59—A-236)

being evolved. The method makes use of a plasma-spraying technique.

The apparatus for plasma spraying consists of six basic mechanisms: Plasma generating torch, a torch coolant supply, a plasma gas supply, a device for storing and delivering the material to be sprayed, a d-c power source, and associated controls and circuity.

Certain types of coating that lend themselves to application with this apparatus are: Thermal barriers, wear-resistant surfaces, corrosion-resistant coatings, and decorative finishes. Descriptions are given of higher melting point materials—tungsten, molybdenum, thoria, calcium zirconate, zirconia, alumina, and various others—which have been applied successfully on thermal barriers and wear-resistant surfaces.

The principles of operation of the plasma-spray technique is outlined and the details of the plasma torch and its operation are described.

Some Observations on the Extrapolation of High-Temperature Ferritic Steel Data..59—A-133... By R. M. Goldhoff, General Electric Company, Schenectady, N. Y. 1959 ASME Annual Meeting paper (in type; to be published in **Trans. ASME—J. Basic Engng.;** available to Oct. 1, 1960).

When calculating long-time working stresses for machine components, the starting point must necessarily be some value of material strength and ductility. Normally such figures involve specific times and service temperatures. Usually tests to determine long-time material properties can be carried out at ultimate service temperatures, but testing times corresponding to design criteria can be prohibitive. In the present case, these values are the 100,000-hr rupture strength and limiting creep stresses for deformation up to 0.5 per cent in the same time period. Obviously, such strength values must be extrapolated from short-time data.

A favorite technique among designers has been the use of one or another time-temperature parameter. Such a technique substitutes higher temperatures for longer times in obtaining data, and the eventual correlation of data permits the long-time strength, but not ductility, extrapolation. The pros and cons of these methods are adequately covered in the literature.

Recently some proposals for the use of combined creep and rupture data have been published which could have an interesting bearing on the long-time design problem. It is the purpose of this paper to discuss these proposals and analyze some extensive creep and rupture data obtained on several ferritic steels in the light of one of them, the Monkman-Grant relationship. In addition, comparisons are drawn with results obtained using the Larson-Miller and Manson-Hafred parameter methods.

The Role of Atmosphere in the Creep-Rupture Behavior of 80 Ni-20 Cr Alloys.. 59—A-122... By Robert Widmer and N. J. Grant, Massachusetts Institute of Technology, Cambridge, Mass. 1959 ASME Annual Meeting paper (in type; to be published in **Trans. ASME—J. Basic Engng.;** available to Oct. 1, 1960).

The microstructure of several 80 Ni-20 Cr alloys was studied after creep at 1500 and 1800 F with respect to the influence of atmosphere. In particular, the propagation of intercrystalline cracks was investigated.

By comparison with tests conducted in argon it can be shown that the atmosphere has a strengthening effect in all cases. The mechanism of this effect changes with the variation of minor constituents in the metals (such as silicon and Mn/S ratio). Crack propagation is strongly affected by the melting process, which influences the purity of the grain boundaries.

Survey of Various Special Tests Used to Determine Elastic, Plastic, and Rupture Properties of Metals at Elevated Temperatures..59—A-112... By F. Garofalo, U. S. Steel Corporation Research Center, Monroeville, Pa. 1959 ASME Annual Meeting paper (in type; to be published in **Trans. ASME—J. Basic Engng.;** available to Oct. 1, 1960).

Testing techniques employed in determining the elastic moduli, that is, Young's modulus, shear modulus, and Poisson's ratio, at room and elevated temperatures are described. These techniques depend on static or dynamic measurements. A comparison and an analysis of test results determined by these two methods are presented. The effect of composition, grain size, and various transformations on the elastic moduli or their temperature dependence is discussed.

A review of techniques and experimental data on the effect of high strain rates on plastic and rupture behavior of metals and alloys at elevated temperatures is presented. It is shown that recovery effects explain qualitatively the results obtained. A brief description of the various stages of recovery is also presented.

The variation of hardness with temperature is discussed for pure metals and alloys, including a description of a typical hot-hardness tester. The relationship between hardness and tensile strength, creep, and creep-rupture behavior is briefly summarized. The use of the hot-hardness tester as a research tool for following solid-state reactions at elevated temperatures is discussed. These reactions may depend on temperature, time, or plastic strain or a combination of these.

Fabrication and Annealing Factors Affecting Grain Size of 18Cr8Ni-Ti Superheater Materials in Steam Boilers..59—A-311... By F. Eberle and J. S. Makris, The Babcock & Wilcox Company, Alliance, Ohio. 1959 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1960).

The effect of cold deformations as encountered in tube and superheater fabrication and of temperature and time of annealing on the grain-size characteristics of 18Cr8Ni-Ti is demonstrated by laboratory experiments with material from six heats of steel.

It is shown that cold-drawn tubing retains a relatively uniform small grain size at annealing temperatures up to

about 1900 to 1950 F and that above this temperature individual grains begin to grow at an accelerated rate, leading to a mixed grain size structure.

Annealing times between 5 and 15 min caused only insignificant differences in the over-all grain size, but extension of exposure to 30 min produced a noticeably larger grain structure.

Small cold deformations as may be introduced into the material by tube-straightening can, when followed by a final anneal, cause excessive localized grain enlargements.

Observations pointed to the possibility that materials with high Ti/C ratios may retain a predominantly small grain size at annealing temperatures as high as 2050 F.

The Extrapolation of Families of Curves by Recurrence Relations, With Application to Creep-Rupture Data..59—A-155... By A. Mendelson and S. S. Manson, Lewis Research Center, NASA, Cleveland, Ohio. 1959 ASME Annual Meeting paper (in type; to be published in **Trans. ASME—J. Basic Engng.**; available to Oct. 1, 1960).

The problem of extrapolating sets of data finds many applications in engineering practice. An example which will be treated in detail in this report is the extrapolation of short-time creep-rupture data to predict long-time life.

A method using finite-difference recurrence relations is presented for direct extrapolation of families of curves.

The method is illustrated by applications to creep-rupture data for several materials and it is shown that good results can be obtained without the necessity for any of the usual parameter concepts.

The Creep-Rupture Properties of 80 Ni-20 Cr Alloys..59—A-119... By Robert Widmer and N. J. Grant, Massachusetts Institute of Technology, Cambridge, Mass. 1959 ASME Annual Meeting paper (in type; to be published in **Trans. ASME—J. Basic Engng.**; available to Oct. 1, 1960).

The creep-rupture properties and the creep behavior of a series of 80 Ni-20 Cr alloys were investigated over the 1200 to 1800-F range. In the group were two vacuum-melted and three air-melted alloys. Among these five heats there were small but important differences in minor constituents such as silicon, manganese, sulfur, and possible tramp elements, primarily as a result of the melting practice in each case.

Of particular interest in this study was the variation in ductility which the various alloys exhibited in creep-rupture tests which lasted from a few minutes to more than 1000 hr.

A close examination of ductility behavior was undertaken by breaking down the creep curve into primary, secondary, and third-stage creep as a function of stress and temperature.

It is shown that the stress-rupture properties are not affected over a wide temperature and stress range by a change in minor constituents, whereas the ductility behavior can vary considerably.

Lubrication

Theoretical and Experimental Analysis of Hydrostatic Thrust Bearings..59—A-152 ...By R. C. Elwell, Assoc. Mem. ASME, and B. Sternlicht, Assoc. Mem. ASME, General Electric Company, Schenectady, N. Y. 1959 ASME Annual Meeting paper (in type; to be published in **Trans. ASME—J. Basic Engng.**; available to Oct. 1, 1960).

This paper presents theoretical and experimental analysis of two types of circular hydrostatic thrust bearings, using incompressible lubricants.

Design equations for load-carrying capacity, stiffness, and flow, are given for three different types of flow restriction—orifice, capillary, and constant flow.

Experimental verification of the equations is shown.

It is seen that each method of restriction imparts its own characteristics on the bearing performance.

Constant flow, for instance, results in the stiffest bearing under certain conditions, and capillary restriction is unaffected by temperature changes.

Railroads

Mobile Reflectoscope Inspection of Railway Car Axles Under Rolling Equipment on the Chesapeake and Ohio Railway Company..59—A-228... By M. F. Melrose and T. E. De Vilbiss, Chesapeake and Ohio Railway Company, Huntington, W. Va. 1959 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1960).

In 1952, the Chesapeake and Ohio Railway Company sustained a costly freight-train wreck caused by a broken journal which started from a crack in the metal.

The railroad had followed the AAR rules of magnetic-particle testing of journal surfaces in all axles of plain bearing type in mounted wheels before they were placed in service.

Following the wreck it was decided that this form of test was not sufficient to eliminate defects which occur after cars are placed in service.

Consideration was given to the use of the ultrasonic reflectoscope for the rapid inspection of car-axle journals for defects while still located in place in the rolling equipment.

A program of investigation was set up by the railway management to prove by practical demonstration whether the reflectoscope would meet the prescribed requirements.

Operating principles of the reflectoscope are described. The development of an experimental mobile unit, a practical reflectoscope carrier, and commercial units are described.

Study of Vibration Frequencies Under Impact Conditions..59—A-250... By G. H. Newcomer, Mem. ASME, Association of American Railroads, Chicago, Ill. 1959 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1960).

A study is presented of vibration frequency characteristics under impact conditions for typical friction-type draft gears used on railroad freight cars.

Equipment used to measure the vibratory or impact forces of draft gears consists of a load cell or transducers and recording instrumentation. Detailed description of this equipment is given in the paper.

A comparison is given between typical instrumentation records showing force-closure clutch action of typical and representative electronic equipment used to measure the vibration forces.

It is concluded that when determining the reaction-force characteristics of draft gears during closure, careful selection of instrumentation must be made.

Instrumentation having a flat frequency response of 0 to 600 cycles is preferred in order to attenuate the higher frequencies encountered in friction-draft-gear characteristics.

Instrumentation having higher frequency response can be used but this usually results in confusion in interpreting the records to determine the fundamental force measurements.

Side view of mobile reflectoscope carrier (59—A-228)

Dynamic Stresses in Traction Motors Resulting From Defective Gearing..59—A-13 ...By E. E. Greene, Assoc. Mem. ASME, General Electric Company, Erie, Pa.; and M. A. Pinney, Mem. ASME, The Pennsylvania Railroad, Altoona, Pa. 1959 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1960).

A program to investigate the relationship between defective gear-tooth profile and traction motor failure was proposed jointly by a railroad and a locomotive builder.

Included as part of the test program was a recommendation that an evaluation of the dynamic loads, stresses, and deflections, resulting from defective gearing, be made by measurement in service.

One type GEA-627 twin-motor assembly was equipped with strain gages and implemented with slip-ring collectors and instrumentation to measure:

1 Shaft stresses in bending and torsion.
2 Stresses in spider armature-head arms.
3 Coil displacement (movement causing wear of insulation).
4 Motor-mounting bolt stresses.
5 Frame head-arm stresses.
6 Quill-drive-cup, cap-bolt stresses.

The stresses or displacements in the foregoing components were evaluated over typical main-line track in a locomotive operated by a regular train crew. Gear combinations were tested that were representative of new, partially worn, badly worn, and "salvage-ground" gearing. The term "salvage-ground" refers to gearing having excessively worn teeth ground to restore satisfactory tooth profile.

The Application of Diesel Engines to Industrial Diesel-Electric Locomotives.. 59—A-227...By R. W. Barrell, General Electric Company, Erie, Pa. 1959 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1960).

The term industrial locomotive, as used in this paper, refers to any type of locomotive designed primarily for moving rail-mounted cars within the confines of any industrial, mining or plant area, or short-line railroad.

Industrial-locomotive service may range from spotting an occasional freight car in a small manufacturing plant to hauling log trains from forest to lumber mills.

Most new industrial locomotives, except those for underground coal mines are now powered by diesel engines.

Rules and problems involved in applying diesel engines to industrial locomotives are discussed.

Operation of the diesel-electric transmission is explained using graphs showing typical speed, horsepower, voltage, and current characteristics.

The importance of economics, simplicity, reliability, good service, and standardization are stressed.

It is concluded that the diesel engine with electric transmission is ideal for industrial locomotives, as evidenced by the large number operating successfully throughout the world.

Stresses in Wrought-Steel Wheel Rims and Their Relation to Wheel Life..59—A-241...By M. S. Riegel, Mem. ASME, American Iron and Steel Institute, Chicago, Ill. 1959 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1960).

The railroad wheel has several divergent functions. It must support the weight of the car or locomotive. By the action of the wheel flanges, it keeps the rolling stock on the track and directs it around curves. In the case of locomotive wheels, the torsion which produces tractive effort is carried by the wheels, there is torsion resulting from the different distances traveled by the wheels on the same axle when rounding curves. This necessarily results in torsion sufficient to slip one wheel on the rail. Wheels thus perform three distinct mechanical functions.

Severe though these mechanical requirements may be, they are almost wholly overshadowed by the stresses imposed by the heating resulting from brake-shoe action. The severe temperature gradients involved in stopping trains or in controlling speed on grades impose stresses which are much more likely to cause distress than the external forces acting on the wheel.

This paper describes certain wheel failures. It describes research to improve wheels. A testing program which determines residual stresses of wheels by laboratory investigation of new wheels is described. Simulated operating conditions and actual service data which give service stresses are also described.

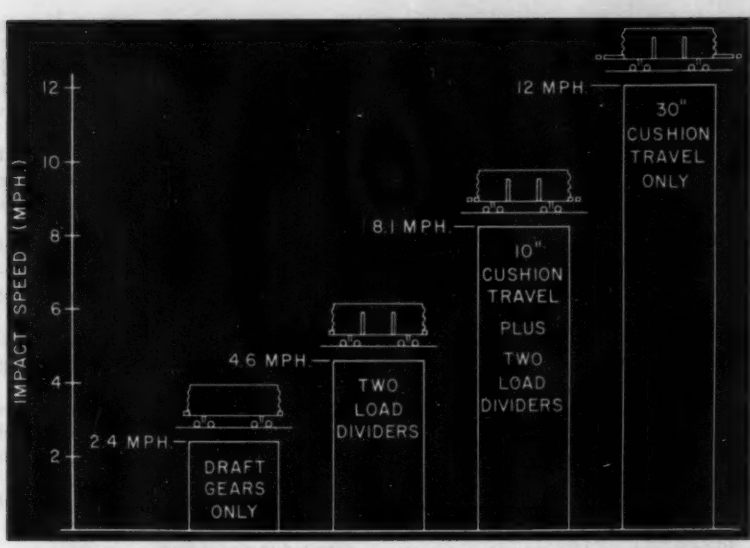
Cushioning Requirements for Adequate Lading Protection..59—A-312...By W. H. Peterson, Pullman-Standard, Hammond, Ind. 1959 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1960).

Lading damage experienced by Class I railroads continues to increase, although there has been an over-all slight decrease in revenue ton-miles of freight carried since 1950. As the speed of service has increased, so has the frequency and severity of coupling impacts between freight cars. Investigations into the cause of damage show that the bulk of damage to fragile types of lading is the result of these impacts.

There are several approaches to alleviating this problem in the form of equipment supplied by the car builder. Means can be provided for subdividing the load such as with compartmentizers; better securement can be provided such as with lading strap anchors and related articles; the car can be cushioned; or various combinations of these arrangements can be provided. Since the introduction of a cushioned underframe car in 1952 there has been continuing effort to improve the design.

A series of full-scale exploratory impact tests were conducted in which a wide range of load subdividing and underframe cushion travels were studied using removable bulkheads and an adjustable cushion fixture in the test cars. The re-

Industrial diesel-electric locomotive moving material between buildings on plant property (59—A-227)



Impact speeds for which various arrangements will offer complete protection to cartons of bottle goods (59—A-312)

sults show that to evaluate the lading protection ability of cushioned cars on the basis of the percentage reductions in coupler force or car-body accelerations alone, or because some seemingly high cushion capacity has been provided, can be very misleading when resilient types of lading are considered. Also, when 30 in. of cushion travel are used, the optimum potential of cushioning is realized and load subdividing and other means of securement are unnecessary.

Process Industries

Chemical Nickel Plating on a Large Scale by the Kanigen Process..59—A-286...By W. J. Crehan, General American Transportation Corporation, Chicago, Ill. 1959 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1960).

The Kanigen process is a process by which many different types of equipment have been plated with a nickel-phosphorous alloy, most of which could not have been electroplated.

Design of items for lining with chemically applied nickel alloy and various problems encountered in large scale coating work are discussed.

Surface preparation for plating of large welded vessels and castings is treated. Plating techniques for large objects to be coated internally and externally are noted.

Comparative costs between the Kanigen process and typical nickel-electroplating processes are touched upon.

Properties of the coating are described as are applications. Most successful applications are found in areas that require the following:

1 Corrosion protection or product-contamination protection.

2 Hard coating.

3 Preparation for soldering or brazing of aluminum or stainless steel.

4 Prevention of galling tendencies in metals.

5 Prevention of stress corrosion in stainless steel.

Some Operating Experiences at a Sewage Sludge Drying Plant..59—A-275...By H. A. Naylor, Jr., Mem. ASME, Whitman, Requardt and Associates, Baltimore, Md. 1959 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1960).

The Back River Sewage Treatment Works is the larger of two major municipal sewage-treatment plants serving the City of Baltimore. The average sewage flow to the works is approximately 150 mgd and the maximum capacity approximately 300 mgd. As a part of the works there is a sewage sludge drying plant.

At present, the sewage entering the works is treated by several processes. The sludge from the primary settling tanks, activated sludge units and from humus tanks is transferred to covered primary and open secondary digesters. When digestion is complete the sludge is partially dewatered on vacuum filters. Dried sewage sludge is a difficult product to handle.

This paper relates some of the operating problems that have occurred at the sludge drying plant of the City of Baltimore's Back River Sewage Treatment Works since initial operation in 1953. The paper also relates some of the studies made and steps taken or being taken to overcome the problems.

Effect of Transient Loads on the Refrigerated-Space Temperature of a Cooling Complex..59—A-181...By C. F. Kayan, Fellow ASME, Columbia University, New York, N. Y. 1959 ASME Annual Meeting paper (in type; to be published in Trans. ASME—J. Engng. for Indus.; available to Oct. 1, 1960).

The influence on space-temperature-time history and heat-exchanger performance of a transient "hot-goods" load suddenly introduced into the refrigerated zone of an insulated structure is of particular interest in cold-storage warehouse operations. Investigation of this topic was undertaken initially via rheoelectric simulation, on a structure with walls of negligible heat capacity, described in a paper by the author at the Ninth International Congress of Refrigeration at Paris, France, in 1955, and carried along further in 1957. Both papers interpreted the contribution of the hot body to heat load via a concept of "transient-body" resistance, timewise variable at the exposed surface of the heat-flow body.

Transient effects with cold-storage loads and finite heat-capacity wall under constant outdoor-temperature conditions, using experimental prototype simulation methods, were further explored in a recent ASME paper.[1] The analysis is now further extended, as a continuation paper, by treating transient effects of an insulated-wall structure having actual heat capacity, and with cyclically varying outdoor-air temperature as well as of solar-radiation effect on the exposed surfaces. The analysis is again coupled to rheoelectric-simulation analogy (RESA) technique.

In this study, the different rates of energy flow are followed, timewise, using specialized electrical-potential transfer processes. This is done in conjunction with the resistance-capacitance representation for the heat-flow components of both hot-load and of wall-structure, previously treated and hence not necessarily to be greatly detailed here beyond the needs of continuity. The net energy-flow is ultimately sensed in the heat-exchanger simulation circuit, as set up for the specific exchanger with given rates of brine-flow, circulating space-air, and initial brine-supply temperature. The space-air temperature is the equilibrium result of structure heat-inflow versus exchanger-outflow. In the illustrative examples, space, wall, and goods temperatures, heat-exchanger energy-flow rates, and exchanger-fluid temperatures are predicted as a function of elapsed time, for several cases covered in the program of experiments.

[1] "Influence of Hot and Cold Storage-Loads on the Refrigerated-Space Temperature of a Cooling Complex," Trans. ASME—*J. Engrg. for Indus.*, vol. 81, 1959.

Materials Handling

Amortization and Determination of Savings of Material-Handling Features..59—A-216... By Fred Schneider, United Merchants and Manufacturers, Inc., New York, N. Y. 1959 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1960).

In this paper, the author explains and recommends the discounting cash flow principles for evaluating alternative investment suggestions.

The author then proceeds to explain, on the basis of examples, the methods for computation of such an approach.

He then proceeds to explain how, with the help of standard cost and flexible budgets, the savings forecast in the original proposal can be checked and followed-up.

Suggestions as to how a vigorous follow-up embodying all the methods can be instituted and carried out are also explained.

Applied Mechanics

Heat-Exchanger Tube-Sheet Design—3. U-Tube and Bayonet-Tube Sheets..59—A-81... By K. A. Gardner, Mem. ASME, The Griscom-Russell Company, Massillon, Ohio. 1959 ASME Annual Meeting paper (in type; to be published in **Trans. ASME—J. Appl. Mech.;** available to Oct. 1, 1960).

Tube sheets of U-tube and bayonet-tube exchangers differ from those of floating-head exchangers in that they receive no external support from the staying or column action of the tubes. The strengthening effect of tube-bending reaction is here investigated, evaluated quantitatively, and presented in the form of simple design factors. These factors are functions of a parameter x_a, a measure of the relative "barreling" rigidity of the tube bundle as compared to the flexural rigidity of the tube sheet.

With stiff tubes and flexible tube sheets (high x_a) the reinforcement due to tube bending is considerable and, in the central region of the tube sheet, the deflection and curvature are essentially independent of any tube-sheet property.

At low x_a, the benefit gained is negligible.

The Approximate Analysis of Certain Boundary-Value Problems..59—A-180... By H. D. Conway, The Ohio State University, Columbus, Ohio. 1959 ASME Annual Meeting paper (in type; to be published in **Trans. ASME—J. Appl. Mech.;** available to Oct. 1, 1960).

A simple method is given which is suitable for the approximate analysis of certain boundary-value problems, including, for example, the small deflections of clamped plates and the torsion of prismatic bars, where the exact solution is the exception, and is not the rule.

The analysis is particularly simple and lends itself well to the use of the digital computer.

The method is applied here to four problems, the uniformly loaded, clamped square, and equilateral-triangle plates, and the torsion of bars of square and hexagonal cross section.

The results agree well with the exact solutions, where these are known.

Thermal Stress in a Viscoelastic-Plastic Plate With Temperature-Dependent Yield Stress..59—A-33... By H. G. Landau and J. H. Weiner, Mem. ASME, Columbia University, New York, N. Y.; and E. E. Zwicky, Jr., Mem. ASME, General Electric Company, Schenectady, N. Y. 1959 ASME Annual Meeting paper (in type; to be published in **Trans. ASME—J. Appl. Mech.;** available to Oct. 1, 1960).

Equations are given for the determination of transient and residual stresses in plates subject to transient temperature distributions, based on the assumption of a viscoelastic, perfectly plastic material obeying a von Mises temperature-dependent yield condition.

A numerical procedure for integrating the equations is developed and applied to the case of a symmetrically cooled plate.

It is found that, for steel, viscoelasticity has little effect on the residual stress distribution, but the temperature dependence of yield stress is important.

The types of residual stress distribution after cooling are similar to those for an elastic-plastic material with constant yield stress, and for this case the residual stress is given approximately by formulas developed earlier for a slowly varying heat input.

Dispersion of Flexural Waves in an Elastic, Circular Cylinder..59—A-84... By Yih-Hsing Pao, Cornell University, Ithaca, N. Y.; and R. D. Mindlin, Mem. ASME, Columbia University, New York, N. Y. 1959 ASME Annual Meeting paper (in type; to be published in **Trans. ASME—J. Appl. Mech.;** available to Oct. 1, 1960).

In this paper, it is shown how the branches of Pochhammer's frequency equation for flexural waves in a circular cylinder may be constructed approximately with the aid of a grid of simpler curves and asymptotic equations for long and short wave lengths.

With very little computation, in comparison with that required in the direct determination of the roots of Pochhammer's equation, a qualitative view is obtained of the relations between frequency, phase velocity, group velocity, and propagation constant, for any branch, as well as some information as to the shapes of the modes.

Normal Modes of Nonlinear Dual-Mode Systems..59—A-93... By R. M. Rosenberg, University of California, Berkeley, Calif. 1959 ASME Annual Meeting paper (in type; to be published in **Trans. ASME—J. Appl. Mech.;** available to Oct. 1, 1960).

A system consisting of two unequal masses, interconnected by a coupling spring, and each connected to an anchor spring, is examined.

The springs may all be unequal and nonlinear, but each resists being compressed to the same degree as being stretched.

The concept of normal modes is rigorously defined, and methods of finding them are given.

A knowledge of these modes reduces the coupled system to two uncoupled ones which can always be integrated in quadrature.

There exists an infinity of systems, of which the linear is one, which can be integrated in closed form.

This approach yields, even for the linear system, new results of great simplicity.

Strain-Hardening Solutions to Axisymmetric Disks and Tubes..59—A-29... By Nicholas Perrone, Assoc. Mem. ASME, Pratt Institute, Brooklyn, N. Y. 1959 ASME Annual Meeting paper (in type; to be published in **Trans. ASME—J. Appl. Mech.;** available to Oct. 1, 1960).

Solutions are obtained for annular disks and tubes made of a linearly strain-hardened material, loaded by a uniform tensile load on the outer boundary.

The strain-hardening is assumed to follow a kinematic hardening flow law.

In addition, a second solution for tubes which accounts for finite deformation is determined.

Some numerical comparisons are made with existing isotropic hardening solutions.

Axially Symmetric Extensional Vibrations of a Circular Disk With a Concentric Hole..59—A-32... By O. G. Gustafsson, SKF Industries, Inc., Philadelphia, Pa.; and T. R. Kane, Mem. ASME, University of Pennsylvania, Philadelphia, Pa. 1959 ASME Annual Meeting paper (in type; to be published in **Trans. ASME—J. Appl. Mech.;** available to Oct. 1, 1960).

Low-frequency extensional vibration of a thin plate can be described satisfactorily by the equations of the theory of generalized plane stress. In order to deal with low-frequency vibrations of thick plates or with high-frequency vibrations of thin plates, it is necessary to use equations which make adequate provision for the phenomenon of coupling between extensional and thickness modes of motion. Such equations have been presented. In the present paper they are

used to study axially symmetric, extensional vibrations of a circular disk with a concentric hole.

First, a résumé of the relevant equations of the plate theory is given. This is followed by the derivation of a frequency equation, a number of limiting cases of which are presented. Finally, the manner in which the frequency spectrum may be computed is described.

ASME TRANSACTIONS

The February, 1960, issues, of the Transactions of the ASME—*Journal of Heat Transfer* and *Journal of Engineering for Industry* (available at $1.50 per copy to ASME Members; $3 to nonmembers)—contain the following:

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59—A-81	59—A-185	59—A-275
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59—A-112	59—A-216	59—A-292
59—A-119	59—A-218	59—A-296
59—A-121	59—A-227	59—A-298
59—A-122	59—A-228	59—A-302
59—A-133	59—A-236	59—A-307
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COMMENTS ON PAPERS

Model Law for Professional Engineers

To the Editor

The Model Law for Professional Engineers as described by W. H. Larkin in Mechanical Engineering, December, 1959, pages 70–71, is still unsatisfactory.

The staff for an engineering organization may consist entirely of licensed professional engineers but if the executive heads and directors are not or only partially so, the public interest will not be sufficiently protected. The trouble arises in the conflict between the desire for business profits and ethical professional standards.

Some years ago I directed an appraisal of a manufacturing industry. It had a number of items for which there was little use. They were given a low value with the result that the total appraised value was less than needed for the mortgage sought. The executives directing the appraisal were primarily businessmen who found no difficulty in assigning another engineer who boosted the appraisal to a satisfactory amount.

An appraiser who leans to the conservative side in his judgments will find difficulty in getting assignments from some large loaning institutions. They look with favor on liberal appraisals as a help to them in making large loans. The firm, partnership, corporation, or joint stock association seeking such business finds it easier to comply with that policy if its chief executives or directors are not licensed professional engineers. A staff man who is a licensed professional engineer has the choice of doing as he is told by them or of seeking another job.

Judgment of what is reasonable or right in appraisals or economic studies is a delicate decision that is made best when the chief executives and directors are sympathetic to the ethics that should guide the licensed professional engineer.

They have got to be imbued with the same high standards. If engineers are to get the professional recognition given many lawyers and doctors they have got to strive for high professional standards whether by the individual or the organization with which they are connected.

Some years ago I was instructed to review the appraisals of several small public utilities. Some of them had well-known names of engineering organizations on them. Study showed they were all on the basis of reproduction cost although it was easy to discover that there was no chance of getting them accepted by the public service commissions involved. Such appraisals used by an investment banker in publicity to justify a stock or bond issue are misleading.

Competition among large engineering organizations for the large volume of business so necessary to the profits they seek makes possible such appraisals if their chief executives or directors are primarily businessmen.

Engineering organizations where all staff men are licensed professional engineers have to their credit large installations of excellent new construction even if their chief executives and directors are not licensed professional engineers.

Trouble comes when the economics of public and private welfare conflict.

Then that type of supervision is unable to chart a course that places the welfare of the public ahead of the demand for profit.

Our support should be thrown to the licensed professional engineer with high ethical standards. The Model Law should be revised to make that support as easy as possible.

Gregory M. Dexter.[1]

[1] Consulting Industrial Engineer, Scarsdale, N. Y. Mem. ASME.

The Fuel Cell

Comment by P. H. Knowlton, Jr.[2]

The authors[3] have written in an interesting manner on an interesting subject. To engineers who have been accustomed to the efficiency limitations of the thermal power cycles because of high-temperature limits, it sounds hopeful to consider an apparatus whose efficiency is not particularly a function of temperature and might have a good efficiency at a moderate-temperature level. It is correspondingly disappointing to read that the fuel apparently must be quite pure and clean; the problems of slag and ash are yet to be solved in an economic fashion.

This writer is among those who are always interested in doing things in new ways, but must agree with the authors' closing sentence concerning the predictable future prospects.

[2] Advance design engineer, Large Steam Turbine-Generator Department, General Electric Company, Schenectady, N. Y. Fellow ASME.

[3] H. A. Liebhafsky and D. L. Douglas, "The Fuel Cell," Mechanical Engineering, August, 1959, vol. 81, pp. 64–68, condensed from Paper No. 59—SA-22.

BOOKS RECEIVED IN LIBRARY

Yardsticks for Industrial Research

By James Brian Quinn. 1959, The Ronald Press Co., New York, N. Y. 224 p., 6 × 9¼ in., bound. $6.50. The problems of evaluating industrial research output for management purposes is discussed. Based principally on an intensive survey of the practices of large and successful companies, criteria and procedure are provided for both the technical and economic assessment of research output. The most feasible techniques, whether quantitive or qualitative are suggested for evaluating fundamental research, offensive research which develops technology for exploiting new markets, and defensive research for improving a company's competitive position in existing markets.

Advances in Astronautics. Vol. 4
Published 1959 by the American Astronautical Society. Distributed by the Plenum Press, Inc., New York, N. Y. 460 p., 7 × 10¼ in., bound. $8. A detailed picture of the scope of current astronautical research is given in this collection of papers which discuss upper atmosphere research and re-entry mechanics, space vehicle design, guidance and instrumentation, satellite mechanics and space exploration, rockets and satellites, and man's environment in space. These papers constitute the proceedings of the Fifth Annual Meeting of the American Astronautical Society held in 1958.

Applied Hydrodynamics
By H. R. Vallentine. 1959, Butterworth & Co., Toronto, Ont., Canada. 272 p., 5¾ × 8¾ in., bound. $10. A practical approach to the theory of hydrodynamics which stresses the adaptation of nonviscuous flow theory to the analysis of real, or viscous fluid flow. Topics discussed include flow of an ideal and a real fluid; graphical flow nets, numerical analysis, and experimental analogies; standard patterns of flow; conformal transformation; and three-dimensional irrotational flow. Emphasis is paid in the test to detailed physical explanations of such concepts as stream function, potential function, and conformal transformation.

Automation, Cybernetics, and Society
By F. H. George. 1959, Philosophical Library, Inc., New York, N. Y. 283 p., 5¾ × 8¾ in., bound. $12. An attempt to clarify the over-all picture of automation and its ramifications. The author begins with the distinction between nonautomatic and automatic control of new and complicated pieces of machinery, and then continues with an examination of the nature of science, and of automation. He then discusses the science of cybernetics, and its many diverse roots in mathematics, the design of high-speed computers, logic, and engineering. He concludes with the implications that cybernetics has for the individual and for society.

Digital Computing Systems
By Samuel B. Williams. 1959, McGraw-Hill Book Co., Inc., New York, N. Y. 229 p., 6¼ × 9¼ in., bound. $7.75. The structure of modern electronic computing systems is described in relatively nonmathematical terms. Beginning with the various codes needed to represent data, the elements contained in modern computers are then described including input and output devices, storage devices, circuits and components, and arithmetic units. A brief review of how digital computers are used to solve scientific, business, and data handling problems concludes the book.

Engineering Education in Russia
By Stephen P. Timoshenko. 1959, McGraw-Hill Book Co., Inc., New York, N. Y. 47 p., 6¼ × 9¼ in., bound. $2.75. An analysis based on the author's knowledge of the prerevolutionary Russian educational system and on a visit to Soviet engineering and technical schools in 1958. The book begins with a brief history of Russian engineering education and then describes some important Russian engineering schools. It also includes a discussion on the present state of Russian engineering education and a comparison of the curriculums of American and Russian schools.

English-Spanish Comprehensive Technical Dictionary. Section 2
By Lewis L. Sell. 1959, McGraw-Hill Book Co., Inc., New York, N. Y. 1079 p., 7½ × 11 in., bound. $35. Orginally designed as a supplement to the first volume published in 1944, this work grew into a full section because of the recent advances in science and technology. This new section covers atomic and nuclear engineering, electronics, telecommunications, rocketry, space travel, television, jet propulsion, and radar. In addition, it provides a 1944–1959 supplement to the fields covered in the first volume.

Grenzschicht—Theorie
By Hermann Schlichting. Third Edition. 1958, Verlag G. Braun, Karlsruhe, Germany, 603 p., 7 × 9½ in., bound. 65 DM. The revision of this standard treatise on boundary-layer theory is of particular importance in the following chapters: Exact solutions of the steady-state boundary-layer equations; thermal boundary layers in laminar flow; boundary layers in compressible flow; origin of turbulence; and the turbulent boundary layer with positive and negative pressure gradient. The chapter reference lists and the general bibliography have also been brought up to date.

Industrial Accident Prevention
By H. W. Heinrich. Fourth Edition. 1959, McGraw-Hill Book Co., Inc., New York, N. Y. 480 p., 6¼ × 9¼ in., bound. $9. The various areas of industrial safety are discussed, from the basis and philosophy of accident prevention to specific details on planning and executing a safety program to fit any size and type of operation. Practical data are included on finding and analyzing facts, selecting and applying corrective measures, the four-step formula for supervision, and a short form safety course. In this edition new chapters are given on safety psychology, nucleonics, small plant safety programs, and a "Skeletal Diagram" which presents, step-by-step, a complete accident prevention method for both safety and production.

Kinematic Analysis of Mechanisms
By Joseph Edward Shigley. 1959, McGraw-Hill Book Co., Inc., New York, N. Y. 351 p., 6¼ × 9¼ in., bound. $7.75. The basic theory of mechanism analysis is presented by means of graphical and analytical methods. Where it is possible to express the motion of a mechanism in the form of an algebraic equation this is also done. In addition to the fundamental concepts, a number of special topics are covered. These include the synthesis of spur gear teeth, Bloch's synthesis of linkages, analysis and synthesis by complex numbers, and the Hrones-Nelson synthesis of linkages. Advanced cam curves, the solution of space mechanisms problems by descriptive geometry, the analytical solution of space mechanism problems, jerk diagrams, and involutometry are also covered.

Masers
By J. R. Singer. 1959, John Wiley & Sons, Inc., New York, N. Y. 147 p., 6 × 9¼ in., bound. $6.50. A study of quantum mechanical amplifiers that approaches the subject from both the classical and quantum mechanical points of view. Beginning with a discussion of the ammonia maser and of the magnetic atomic beam system, there is a section on an optically pumped frequency standard and a description of electron paramagnetic resonance. Two-level masers are then treated with emphasis on their possibilities for millimeter and submillimeter wave generation, and numerical illustrations are employed in an examination of three-level cavity masers. The book concludes with the theory and experimental results of the traveling wave masers.

Mathematics in Physics and Engineering
By J. Irving and N. Mullineux. 1959, Academic Press, Inc., New York, N. Y. 883 p., 6¼ × 9¼ in., bound. $11.50. Emphasis is placed on the application of mathematical theory, and worked examples illustrating this theory and its ramifications are drawn from many different fields of applied science such as elasticity, supersonic flow, electromagnetism, wave mechanics, and heat flow. Topics discussed include partial differential equations, ordinary differential equations, Bessel and Legendre functions, Laplace and other transforms, matrices, calculus of variations, complex variable theory and conformal transformations, calculus of residues, transform theory, numerical methods, and integral equations.

Nucleonics Fundamentals
By David B. Hoisington. 1959, McGraw-Hill Book Co., Inc., New York, N. Y. 410 p., 6¼ × 9¼ in., bound. $9.50. A broad view of the field of nucleonics is presented, with atomic and nuclear physics being included to the extent necessary for an understanding of engineering applications. Topics discussed include atomic and nuclear structure, radioactivity, induced nuclear transformations, particle accelerators, radiation protection, instrumentation, nuclear fission, research reactors, nuclear and thermonuclear power, and the production of nuclear materials.

Programming for Digital Computers
By Joachim Jeenel. 1959, McGraw-Hill Book Co., Inc., New York, N. Y. 517 p., 6 × 9¼ in., bound. $12. Intended for readers with no previous programming experience, this test presents a methodical approach to programming which is based on the representation of a program as a logical structure of standardized building blocks. This provides the programmer with a conceptual framework within which he can create a program more rapidly, and permits programs for different purposes and different machines to be represented in a uniform manner. Recent developments and specific topics covered include indirect addressing, randomized addresses, random-access storage, in-line processing, concurrent operations, and nonmachine languages.

The Properties, Physics, and Design of Semiconductor Devices
By John N. Shive. 1959, D. Van Nostrand Co., Inc., Princeton, N. J. 487 p., 6¼ × 9¼ in., bound. $9.75. A text that bridges the gap between elementary presentations of semiconductor theory and highly theoretical treatments. In the first part semiconductor devices are discussed from an empirical point of view. The nature, behavior, and uses of thermistors, varistors, photoelectric cells, and transistors are described, and fabrication techniques and typical application are considered. Part two discusses the solid-state electronics of semiconductors, and leads to a theoretical understanding of the physics underlying their operation. It provides a foundation for those interested in the physical and engineering features of semiconductor device design.

Russian-English Atomic Dictionary
By Eugene A. Carpovich. Second Edition. 1959, Technical Dictionaries Co., Box 144, New York, N. Y. 317 p., 5¾ × 8½ in., bound. $12. A new edition comprising over 23,000 Russian entries covering primarily the fields of nuclear science and technology, physics, including theoretical, atomic and molecular physics, physics of solids, crystallography, and mathematics. Many terms from chemistry and chemical engineering are also included. To conserve space in this edition most biomedical terms have been replaced by physical and mathematical terms.

Russian for the Scientist
By John and Ludmilla B. Turkevich. 1959, D. Van Nostrand Co., Inc., Princeton, N. J. 255 p., $6^1/_4 \times 9^1/_4$ in., bound. \$5.95. This elementary text begins at a leisurely pace, helping the student to pronounce correctly, to develop a recognition knowledge of cognates, and to become familiar with the basic points of grammar. The use of cognates is stressed in vocabulary building. Simplified chemistry texts are introduced at an early stage, and as a broader command of vocabulary and grammar is developed, unedited selections are drawn from Soviet encyclopedias and textbooks in aeronautical engineering, biology, physics, and chemistry.

Sounding Rockets
By Homer E. Newell, Jr. 1959, McGraw-Hill Book Co., Inc., New York, N. Y. 334 p., $6^1/_4 \times 9^1/_4$ in., bound. \$12.50. A comprehensive study of the principal rockets used for high-altitude research, particularly geophysical and solar research. All of the principal upper-air sounding rockets of the United States, England, France, and Japan are covered. High-altitude research results, handling and launching procedures, instrumentation techniques, and special facilities required are described in relation to individual rockets, and a general consideration of rocket theory, artificial earth satellites, and future sounding rockets are given. A fairly complete historical treatment for most of the rockets discussed is also given.

Theoretical Elasticity
By Carl E. Pearson. 1959, Harvard University Press, Cambridge, Mass. 218 p., $5^3/_4 \times 8^3/_4$ in., bound. \$6. A thorough discussion of modern methods and results in the field of theoretical elasticity. Extensive mathematical experience is not required, and particular attention is given to providing requisite mathematical background material where it is appropriate. Topics covered include stress, deformation, basic equations of linear elasticity, variational methods, thermoelasticity, time-dependent problems, and nonlinear elasticity.

Trocknungstechnik. Vol. 2. Trockner und Trocknungsverfahren
By O. Krischer and K. Kröll. 1959, Springer-Verlag, Berlin, Germany. 588 p., $6^1/_2 \times 9^1/_4$ in., bound. 69 DM. This second volume of a treatise on driers and drying processes discusses the factors to be considered in selecting a drier, drier capacities, design of driers, and drying processes as applied to various materials. Special topics considered include changes in materials during drying; recovery of evaporated solvents in air drying; vacuum drying; and contact drying.

American Petroleum Refining
By H. S. Bell. Fourth Edition. 1959, D. Van Nostrand Co., Inc., Princeton, N. J. 538 p., $6^1/_4 \times 9^1/_4$ in., bound. \$12.50. An over-all survey of oil-refining processes and equipment, including flow charts and operating data. Included is information on the chemical and physical properties of hydrocarbons, the characteristics of crude oils and products, and the relationship of auxiliary services such as power, water, waste disposal, and fire protection. The practical aspects of the subject are stressed rather than theoretical discussions. This edition has been revised so as to conform with present-day practice.

Digital and Sampled Data Control Systems
By Julius T. Tou. 1959, McGraw-Hill Book Co., New York, N. Y. 631 p., $6^1/_4 \times 9^1/_4$ in., bound. \$15. The basic theory and available techniques for the analysis and design of digital and sampled-data control systems is presented. The subject matter is divided into three parts dealing with introductory material, system analysis, and system design. It covers such advances as multirate sampling techniques, systems with nonsynchronized samplers, cyclic variable-rate sampled-data systems, adaptive control, statistical design, simulation, and systems with finite sampling duration.

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Engineering Societies Library books, except bibliographies, handbooks, and other reference publications, may be borrowed by mail by ASME members for a small handling charge. The Library also prepares bibliographies, maintains search and translation services, and can supply a photoprint or a microfilm copy of any item in its collection. Address inquiries to R. H. Phelps, Director, Engineering Societies Library, 29 West 39th Street, New York 18, N. Y.

The Economics of Nuclear Power, Including Administration and Law. Vol. 2
Edited by I. R. Maxwell and others. 1959, Pergamon Press, Inc., New York, N. Y. 419 p., $6^1/_4 \times 9^1/_4$ in., bound. \$17. A continuation of other volumes in this series (Progress in Nuclear Energy, Series VIII), the present volume discusses the world demand for nuclear energy; nuclear fuel supply and costs, with particular reference to uranium mining costs; the generation of nuclear energy, including its application to purposes other than electricity generation; the cost of generating electricity for nuclear reactors; and the effect of reactor design on costs. Nuclear power programs in various countries are also discussed.

Experimental Nuclear Physics. Vol. 3
Edited by E. Segrè. 1959, John Wiley & Sons, Inc., New York, N. Y. 811 p., $6 \times 9^1/_4$ in., bound. \$23. This volume, which completes the series, discusses radioactive decay, alpha-radioactivity, gamma-rays, beta-rays, and particle accelerators. Each section is intended to bring the reader up to date in experimental techniques, point out the significant facts and data, and indicate the broad lines of theoretical interpretation. In addition, the bibliographies included enable the reader to go directly to the original literature for further details.

Frequency Response for Process Control
By William I. Caldwell and others. 1959, McGraw-Hill Book Company, Inc., New York, N. Y. 395 p., $6^1/_4 \times 9^1/_4$ in., bound. \$11.50. The fundamental methods of frequency response are presented, and their application to the analysis, testing, and design of process-control systems is discussed. The first part, which is devoted to theory, considers velocity lag, linear lag, and stability considerations. Methods of analysis are presented with emphasis on the damped response method, while the coverage of controller responses includes control charts for a variety of responses. Closed-loop responses are explained and disturbances are discussed with regard to their magnitude and location in the control loop. The second part of the book consists of the application of these fundamentals to actual process-control problems.

Fuels and Lubricants
By M. Popovich and Carl Hering. 1959, John Wiley & Sons, Inc., New York, N. Y. 312 p., $6 \times 9^1/_4$ in., bound. \$8.50. Summarizing material from a great many sources, the authors discuss the important fuels, including boiler, internal-combustion engine, and jet fuels, as well as rocket propellants and nuclear fuels. Emphasis is placed on the correlation between the properties of fuels and lubricants and their performance in an engine or machine, as well as on the significance of the standard tests that are conducted on these materials. Particular features of the volume include discussions on synthetic lubricating oils, and a tabulation of octane numbers of many pure hydrocarbons.

Gas Chromatography
By A. I. M. Keulemans. Second Edition. 1959, Reinhold Publishing Corp., New York, N. Y. 234 p., $6^1/_4 \times 9^1/_4$ in., bound. \$7.50. The practical and theoretical aspects of gas-liquid and gas-solid chromatography are thoroughly covered. In this edition a number of new developments are included among which are the development, for highly critical separations, of columns having an extremely large number of theoretical plates; the introduction of new and highly sensitive detection systems, and the rise of gas-solid chromatography for special purposes, such as the characterization of catalyst surfaces and the separation of isotopes.

Heat-Sealing and High-Frequency Welding of Plastics
By Hans Peter Zade. 1959, Interscience Publishers, Inc., New York, N. Y. 211 p., $5^3/_4 \times 8^3/_4$ in., bound. \$5.75. A summary of the present knowledge regarding these two fabricating processes is presented along with a survey of their increasing range of industrial application. Information is given on the physical properties of thermoplastics in relation to their welding properties, and there is an extensive review of heat-sealing and high-frequency welding equipment, illustrated by photographs of representative types of welding machines. An index of international patents relating to the welding of plastics is included, as is an index to trade names of thermoplastics.

Hydraulische Antriebe
By A. Dürr and O. Wachter. Fourth Edition. 1959, Carl Hanser Verlag, Munich, Germany. 258 p., $6 \times 8^1/_2$ in., bound. 19.80 DM. Avoiding purely theoretical discussion, this book describes the details and illustrates the practical applications of hydraulic drives and controls for all types of machine tools. In this new edition a section has been added on electrohydraulic devices and an appendix containing standard symbols in the field of hydraulic mechanisms is included.

Hyperstatic Structures. Vol. 1
By I. A. L. Matheson. 1959, Academic Press, Inc., New York, N. Y. 474 p., $6^1/_4 \times 10$ in., bound. \$15.50. The field of hyperstatic structures is treated as a coherent pattern by means of a diagrammatic "family tree" which emphasizes the relationships existing among the various theorems. Sections included deal with the energy theorems of structural analysis, general theorems for linear elastic structures, general methods for linear hyperstatic structures, moving loads on structures, frames with rigid joints, arches, stability of struts and frameworks, and matrix methods.

An Introduction to Plasticity
By William Prager. 1959, Addison-Wesley

Publishing Co., Inc., Reading, Mass. 148 p., $6^1/_4 \times 9^1/_4$ in., bound. \$9.50. Particular emphasis is placed on the effects of platics deformations on the mechanical behavior of structures. In most cases highly simplified stress-strain relations are used that describe idealized rigid-plastic or elastic-plastic behavior. Due to these simplifications, satisfactory results are obtained not only for beams and trusses, but also for frames, plates, and shells. The discussion on finite deformations indicates that the results may be applied to forming processes such as rolling, extruding, and drawing.

Introduction to the Laplace Transform
By Dio L. Holl and others. 1959, Appleton-Century-Crofts, Inc., New York, N. Y. 174 p., $5^3/_4 \times 8^1/_2$ in., bound. \$4.25. The aspects of the Laplace transform treated include transforms of discontinuous functions and the convolution theorem; unit functions, impulse functions, and periodic functions; applications to ordinary differential equations; applications to linear partial differential equations; and transforms of functions with infinite discontinuities. The treatment of the subject is restricted to real functions

Inventions, Patents, and Their Management
By Alf K. Berle and L. Sprague de Camp. 1959, D. Van Nostrand Co., Inc., Princeton, N.J. 602 p., $5^3/_4 \times 8^1/_2$ in., bound. \$12.50. While not advocating that inventors act as their own patent attorneys, this book does indicate how to proceed with an invention in its early stages, how to choose a patent attorney, how to co-operate with him to get the most from his services, and how to read, understand, and evaluate patents. In addition, the commercial exploitation of inventions is covered. It is shown that by following the correct procedure in obtaining patents much time and expense can be saved.

Kinematics
By Virgil Moring Faires. 1959, McGraw-Hill Book Co., Inc., New York, N. Y. 468 p., $6^1/_4 \times 9^1/_4$ in., bound. \$8.50. The aspects of motion that are of most general interest to engineers are covered. Topics discussed include equations of plane motion, cams, centros and velocities, relative velocities, velocities by components, relative accelerations, coriolis acceleration, gear trains, flexible connectors and friction wheels, and synthesis of mechanisms.

Kinetics of High-Temperature Processes
Edited by W. D. Kingery. 1959, John Wiley & Sons, Inc., New York, N. Y. 326 p., $8^1/_4 \times 10^3/_4$ in., bound. \$13.50. Dealing with the kinetics of condensed-phase processes at elevated temperatures, the papers included in this volume constitute a record of current efforts to apply the knowledge of these processes to complex systems. The topics discussed include imperfections and diffusion in nonmetals, diffusion in liquids and liquid-solid reactions, nucleation and grain growth, sintering and vitrification, phase transformations, solid-solid and solid-gas reactions.

Mathematical Methods of Operations Research
By Thomas L. Saaty. 1959, McGraw-Hill Book Co., Inc., New York, N. Y. 421 p., $6^1/_4 \times 9^1/_4$ in., bound. \$10. Mathematical methods essential to operations research are presented. Following an introductory chapter on the history and basic concepts of operations research the book continues with methods used in formulating mathematical models; optimization, programming, and game theory; probability, statistics, and queueing theory; and a discussion on creativity in relation to the solution of problems.

ASME BOILER AND PRESSURE VESSEL CODE

Interpretations

The Boiler and Pressure Vessel Committee meets regularly to consider "Cases" where users have found difficulty in interpreting the Code. These pass through the following procedure: (1) Inquiries are submitted by letter to the Secretary of the Boiler and Pressure Vessel Committee, ASME, 29 West 39th St., New York 18, N. Y.; (2) Copies are distributed to Committee members for study; (3) At the next Committee meeting interpretations are formulated to be submitted to the ASME Board on Codes and Standards, authorized by the Council of the Society to pass upon them; (4) They are submitted to the Board for action; (5) Those which are approved are sent to the inquirers and are published in Mechanical Engineering.

(The following Case Interpretations were formulated at the Committee meeting Nov. 20, 1959, and approved by the Board on Jan. 25, 1960.)

Case No. 1268

Interpretation of Pars. UW-11 and UW-12 and Table UW-12

Vessels Constructed with No Radiographic Examination

Inquiry: In unfired pressure vessels with welded joints neither fully radiographed nor spot radiographically examined, as under column (c) of Table UW-12, seamless shells and heads are required by Par. UW-11(b)(3) to be designed using 80 per cent of the allowable stress value prescribed for the material in Subsection C. What are the requirements for other parts in vessels having joints not spot examined, such as flat heads, flanges, nozzle reinforcements, etc.?

Reply: It is the opinion of the Committee that in deleting Par. UW-52(b) of the 1956 Edition, it was the intent to transfer elsewhere in Section VIII of the Code the basic requirements of that paragraph, and that in all welded vessels built under Column (c) of Table UW-12, 80 per cent of the allowable stress value shall be used in design formulas and calculations not involving weld joint efficiency. This includes determination of the required thickness in Par. UG-37(b), to be used in computing the required cross-sectional area of reinforcement for openings in these vessels.

Case No. 1269

(*Special Ruling*)

Welded GS11A-T4 (6061-T4) Aluminum Alloy

Inquiry: Since Table UNF-23 does not list allowable stress values for welded GS11A-T4 and Note No. 1 does not apply to this alloy, and further, since the tensile strengths of joints made by welding material in the -T4 and -T6 tempers are essentially equal, may the allowable stress values listed in Table UNF-23 for the welded -T6 temper be used for this alloy welded in the -T4 temper?

Reply: It is the opinion of the Committee that the allowable stress values listed in Table UNF-23 for welded GS11A-T6 may be used also for welded GS11A-T4, provided the welding procedures, welders, and welding operators are qualified in accordance with the requirements in Section IX for welding GS11A-T6.

Proposed Revisions and Addenda to Boiler and Pressure Vessel Code . . .

As need arises, the Boiler and Pressure Vessel Committee entertains suggestions for revising its Code. Revisions approved by the Committee are published here as proposed addenda to the Code to invite criticism. If and as finally approved by the ASME Board on Codes and Standards, and formally adopted by the Council, they are printed in the semi-annual addenda supplements to the Code. Triennially the addenda are incorporated into a new edition of the Code.

In the following the paragraph numbers indicate where the proposed revisions would apply in the various sections of the Code.

Power Boilers, 1959

Par. P-9(a) Delete the last sentence.

Table P-7 Add the material and stress values given below.

Material Specifications, 1959

SA-167 Specification for Corrosion-Resisting Chromium-Nickel Steel Plate, Sheet and Strip. *Delete this specification*

Unfired Pressure Vessels, 1959

Par. UG-32(c) Revise the last definition of E to read:

For seamless heads, use E = 1, except for hemispherical heads furnished without a skirt, in which case use the efficiency of the head-to-shell joint.

Par. UG-32(d) and (e) Delete reference numbers and footnotes 3 and 4.

Par. UG-32(e) Following the words crown radius add: (see j).

Par. UG-37(b) Add an item 4 to the definition of t_r to read:

(4) When the opening is in a vessel built under Par. UW-12(c), the value of S used in computing t_r shall be 80 per cent of the allowable stress value prescribed for the material in Subsection C.

Par. UW-11 Radiographic Examination Revise to read:

Par. UW-11 Radiographic Examination (a) *Full Radiography*

The following butt welded joints made in accordance with Types No. 1 and No. 2 of Table UW-12 shall be examined radiographically for their full length in the manner prescribed in Par. UW-51:

(1) Joints in vessels used to contain lethal substances (see Par. UW-2(a)).

(2) Joints in plates or vessel walls in which the thickness at the welded joint exceeds $1^1/_2$ in., or exceeds the lesser thicknesses prescribed in Pars. UCS-57, UHA-33, UCL-35 or UCL-36 for the materials covered therein.

(3) Joints in unfired steam boilers, the design pressure of which exceeds 50 psi (see Par. U-1(e)(2)).

(4) Butt welds of inserted type nozzles as shown in Fig. UW-16.1(q-1), (q-2), (q-3) and (q-4), attaching the nozzle to the vessel wall, when used in a vessel or vessel section that is required to be radiographed under (1), (2), (3), or (6) hereof.

Note: Nozzle and manhole attachment welds which are not of the butt type need not be radiographed.

(5) Joints in nozzles, sumps, etc. in a vessel or vessel section that is required to be radiographed under (1), (2), (3), or (6) hereof, except that circumferential welded butt joints in nozzles and sumps not exceeding 10 in. nominal pipe size or $1^1/_8$ in. wall thickness need not be radiographed.

Note: This provision applies to the fabrication of the part itself, and not to the method of attachment to the vessel, which is provided for in (4).

(6) All longitudinal and circumferential joints in a vessel or vessel section where the design of the vessel or vessel section is based on the use of the joint efficiency permitted by Par. UW-12(a), including, in the case of a vessel section, the circumferential butt welds joining it to adjacent shell sections or heads, with the following exception:

The joint between a shell section and a hemispherical head without a skirt need not be fully radiographed unless required by (1), (2), or (3) hereof, or unless the design of the head itself is based on the use of the joint efficiency permitted by Par. UW-12(a).

(b) ***Spot Radiography.*** All longitudinal and circumferential butt welded joints made in accordance with Types No. 1 and No. 2 of Table UW-12 which are not required to be fully radiographed by (a) shall be examined by spot radiographing in accordance with Par. UW-52, except as described in (c).

Note: Fillet and/or corner welds permitted by other paragraphs, such as for nozzle and manhole attachments, welded stays, flat heads, etc. need not be spot radiographed.

(c) ***No Radiography*** Except as required in (a), no radiographic examination of welded joints is required when the vessel or vessel part is designed for external pressure only, or when the vessel design complies with Par. UW-12(c).

Par. UW-12 Joint Efficiencies Revise to read:

Par. UW-12 Joint Efficiencies Table UW-12 gives the joint efficiencies, E to be used in the formulas of this Section of the Code for joints completed by an arc or gas welding process. The joint efficiencies depend on the type of joint and on the degree of examination of the longitudinal and circumferential joints.

(a) The value of E not greater than that given in column (a) of Table UW-12 shall be used in the design calculations for fully radiographed butt welds (see Par. UW-11(a)).

(b) The value of E not greater than that given in column (b) of Table UW-

Materials and Stress Values to Be Added and Revisions to Be Made to Table P-7

For Metal Temperatures not Exceeding Deg F

Materials and Specification Number	Grade	Nominal Composition	Min Tensile	Notes	−20 to 100	200	300	400	−20 to 400	500	600	650	700
Pipes & Tubes													
Seamless Alloy Steel													
SA-213	TP 321	18Cr-10Ni-Ti	75000	(13)	18750	18750	17000	15800	...	15200	14900	14850	14800
SA-213	TP 321H	18Cr-10Ni-Ti	75000	(13)	18750	18750	17000	15800	...	15200	14900	14850	14800
Seamless Low-Alloy Steel													
SA-213	T2	$^1/_2$Cr-$^1/_2$Mo	60000	...	...	...	...	...	...	...	...	15000	15000
SA-423	...	$^3/_4$Cr-$^1/_2$Ni-0.4Cu	60000	...	15000	15000	15000	15000	...	15000	15000	15000	...
Forgings													
Low-Alloy Steels													
SA-182	F21	3Cr-0.9Mo	70000	...	...	...	...	17500	...	16800	16000	15600	15100

	750	800	850	900	950	1000	1050	1100	1150	1200	1250	1300	1350	1400	1450	1500
SA-213 TP-321	14700	14550	14300	14100	13850	13500	...	...	...	...	...	...	...	...	...	...
SA-213 TP-321H	14700	14550	14300	14100	13850	13500	13100	10300	7600	5000	3300	2200	1500	1200	900	750
SA-213 T-2	15000	14400	13750	12500	10000	6250	...	...	...	...	...	...	...	...	...	...
SA-423	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
SA-182 F-21	14600	13900	13200	12000	9000	7000	5500	4000	2700	1500	...	...	...	...	...	...

12 shall be used in the design calculations for butt welded joints in vessels or parts of vessels that are spot-radiographically examined in accordance with the requirements of Pars. UW-11(b) and UW-52.

(c) The value of E not greater than that given in column (c) of Table UW-12 shall be used in the design calculations for welded joints in vessels that are neither fully radiographed nor spot-radiographically examined, provided that in all other design calculations a stress value equal to 80 per cent of the allowable stress value prescribed for the material in Subsection C is used.

(d) A value of E not greater than 0.80 may be used in the formulas of this Section of the Code for joints completed by forge-welding or by any of the pressure-welding processes given in Par. UW-27(2), provided the welding process used is permitted by the rules in the applicable parts of Subsection C for the material being welded. The quality of such welds used in vessels or parts of vessels shall be proved as follows: Test specimens shall be representative of the production welding on each vessel. They may be removed from the shell itself or from a prolongation of the shell including the longitudinal joint, or, in the case of vessels not containing a longitudinal joint, from a test plate of the same material and thickness as the vessel and welded in accordance with the same procedure. One reduced-section tension test and two side-bend tests shall be made in accordance with, and shall meet the requirements of Pars. Q-6 and Q-8, or QN-6 and QN-8, Section IX.

Table UW-12: In Footnotes 1 and 2, change (b) to (a); (c) to (b).

In Footnote 3 delete present wording and replace with the following:

[3] The maximum allowable joint efficiencies shown in this column are the weld joint efficiencies multiplied by 0.80 (and rounded off to the nearest 0.05), to effect the basic reduction in allowable stress required by the Code for welded vessels that are not spot examined. See Par. UW-12(c).

Par. UW-35(b) Revise to read:

(b) When a single-welded butt joint is made by using a backing strip which is left in place (Type No. 2 of Table UW-12), and adding filler metal from one side only, the requirement for reinforcement applies only to the side opposite the backing strip.

Par. UF-5(b) Revise to read:

The ladle analysis of forgings to be fabricated by welding shall not exceed carbon 0.35 per cent. When the welding, however, involves only minor nonpressure attachments as limited in Par. UF-32, or repairs as limited in Par. UF-37, the carbon content shall not exceed 0.50 per cent by ladle analysis. When, by ladle analysis, the carbon content exceeds 0.50 per cent, no welding is permitted.

Par. UF-5(c) Revise to read:

Materials, other than austenitic steels, subjected to liquid quench and temper heat treatment shall be fabricated without welding or brazing except as otherwise provided in the code.

Par. UF-31(b)(1) Revise first sentence to read:

Vessels fabricated by forging material to be liquid quenched and tempered shall be subjected to this heat-treatment in accordance with...etc. (remainder as is).

Par. UF-32(a) Revise to read:

Vessels which are constructed of material other than austenitic steel and which have been liquid quenched and tempered shall be fabricated without welding or brazing, except as otherwise provided in the code.

Par. UF-32(b) Add the following as a second paragraph to read:

Procedure qualification in accordance with Section IX shall be performed with the heat treatment condition of the base metal and weld metal as in Par. UF-31 as contemplated for the actual work.

Par. UF-32(c) Revise the first sentence to read:

When the carbon content of the material exceeds 0.35 per cent by ladle analysis, the vessel or part...etc.

Par. UF-32(c)(1) Revise to read:

(1) The suitability of the electrode and procedure shall be established by making a groove weld specimen as shown in Fig. Q-3 of Section IX in material of the same analysis and of thickness in conformance with Table Q-13. The specimen before welding shall be in the same condition of heat treatment as the work it represents and after welding the specimen shall be subjected to heat treatment equivalent to that contemplated for the work. Tensile and bend tests, as shown in Fig. Q-6 and Fig. Q-7 (Figs. Q-7.1 and Q-7.2) respectively, shall be made. These tests shall meet the requirements of Pars. Q-6 and Q-8 of Section IX. The radius of the mandrel used in the guided bend test shall be as follows:

Specimen Thickness	Radius of Mandrel (B)*	Radius of Die (D)*
$3/8$ in.	$1\,1/4$ in.	$1\,11/16$ in.
t	$3\,1/3\,t$	$4\,1/3\,t + 1/16$ in.

* Corresponds to dimensions B and D in Fig. Q-8 in Section IX, and other dimensions to be in proportion.

Any cutting and gouging processes used in the repair work shall be included as part of the procedure qualification.

Par. UF-37(b)(1) Revise the first sentence to read:

Material having carbon content of 0.35 per cent or less (by ladle analysis).

Par. UF-37(b)(2) Revise the first sentence to read:

Material having carbon content over 0.35 per cent (by ladle analysis).

Par. UF-38 Revise to read:

The repair of welds of forgings having carbon content not exceeding 0.35 per cent by ladle analysis shall follow the requirements of Par. UW-38.

Par. UCS-5(b) Revise to read:

Carbon or low-alloy steel having a carbon content of more than 0.35 per cent by ladle analysis shall not be used in welded construction or be shaped by oxygen cutting, (except as provided elsewhere in the code)

Par. UCS-25 Revise to read:

Corrosion Allowance. Vessels that are to be used in com pressed-air service, steam service, or water service shall be provided with a corrosion allowance on the metal surface in contact with such substance of not less than the smaller of one-sixth of the calculated plate thickness or $1/16$ in. This requirement does not apply to vessels designed in accordance with Par. UW-12(c). The minimum required thickness of $1/4$ in. for unfired steam boilers (see Par. UCS-16(b)) may include the corrosion allowance specified by this rule.

Table UHA-23 Delete reference to specification SA-167.

Welding Qualifications, 1959

Table Q-11.1 Delete reference to specification SA-167 under P-Number 8.

Table Q-11.1 Add the following specifications as given below:

P-Number 8

Material	Specification	PSI Min. Tensile	Type of Material
SA-213	Grade TP 321H	75,000	AISI 321H Seamless Alloy Steel Tubes
SA-240	Grade 316 L	70,000	AISI 316L Plate

Current Engineering Events, News, and Comment

E. S. NEWMAN
News Editor

THE ROUNDUP

ASME President Cisler in CIPM Address Describes U. S. Management's Role in a Decade of World Change

At the Annual Dinner of the Council for International Progress in Management (U.S.A.), Inc., the main address was delivered by Walker L. Cisler, President and Fellow of The American Society of Mechanical Engineers.

The Council held this annual dinner in the Terrace Room of the Plaza Hotel, New York, N. Y., on Jan. 20, 1960. Leaders in industry, education, and government were present to hear Mr. Cisler speak. At the dais were two other men of the ASME: Andrew B. Holmstrom, Fellow ASME, vice-president of the Norton Company, and 1960 president of CIPM; Allen H. Ottman, Affiliate ASME, president, Forbes & Wagner, Inc., and former director of the Council.

Mr. Cisler, president of Detroit Edison, is an engineer whose work has brought him into contact with engineers of many other nations, including those of the Soviet Union. In his speech to the Council for International Progress in Management, he spelled out the challenge that Russia presents to our business management.

A Champion Is Challenged. Mr. Cisler reminded his audience that we have grown accustomed to being the most successful of all nations. We have achieved the world's highest standard of living; we have extended aid to other countries; and we have maintained a defensive military structure to safeguard the free world.

"But now," he said, "we find that the champion is being challenged, not by some of the inescapable laws of economics, but by another formidable, capable nation with extensive resources, where human endeavor is tightly organized to serve the purposes of an all-powerful state."

The challenge is apparent to us as an economic one, and we feel it in our relations with all industrialized nations. After World War II we helped reconstruct many nations. Much managerial and technical talent went into the project of rehabilitation, the tasks of renewal.

"Today," he said, "we are almost startled to see how well our colleagues in other lands have put our principles to work according to their own cultural and industrial traditions."

He pointed out that in 1958 the nations of Western Europe produced more steel than we did in the United States.

In 1959 they produced about four million automobiles.

All this was done economically and efficiently, and we have felt the competition. Numerous overseas producers have undersold us in our own back yard.

Along with the resurgence of production in Western Europe, we have seen the development of a common market by six vigorous nations. That has, in turn, encouraged seven more European nations to develop a similar mutuality of economic interests.

But the challenge of the Soviet Union is different.

Mr. Cisler said, "Last summer, and the summer before, I visited the Union of Soviet Socialist Republics with groups representing the Edison Electric Institute and the Association of Electric Illuminating Companies. We went there to study electric-power development and to exchange information on a person-to-person basis—an experiment in understanding that I found highly rewarding."

The New Opponent. The Soviet Union is about $2^1/_2$ times as large as the continental United States, bigger than China and India combined. It represents $^1/_6$ of the world's land area. It possesses large fuel and hydraulic reserves, expensive mineral resources, together with vast forests and vast opportunities for farming a fertile soil. About 210 million people live there. They speak more than 100 languages, are divided into 15 republics.

"The population has been developing eastward," Mr. Cisler said. "New industrial projects, the forerunners of future cities, are rising in Siberia—which has extensive regions that are favorable for economic development—and in other areas having similar natural resources. In some respects it reminds me of our old west, with bulldozers in place of buffalo, and engineers and technicians instead of cowboys."

He explained that the Russian state program of industrialization is creating cities and factory towns out of what was, not so long ago, a nation of peasant farmers and nomads. Forty-eight per cent of the people now live in urban communities. A central control is exercised over the economy. The state owns about 91 per cent of all industrial and three fourths of the agricultural facilities including land and basic farm machinery. This complex of enterprises is subject to the control of a single authority—the council of ministers and its chairman, Nikita Khrushchev. Some decentralization has been undertaken with the establishment of 105 economic districts. Each has its economic council which sets production objectives and calls for the necessary manpower and other necessities to meet these objectives. Then the central control decides what can be allotted.

"In theory," said Mr. Cisler, "and to a large extent in practice, here is complete control of material, economic, and human resources. Chairman Khrushchev says that this kind of system will overtake a heterogeneous system such as private capitalism. This is his opinion, and what it means is that they are going to try hard, which is natural. The question on our side is, how well are we going to do?

"Productivity," said Mr. Cisler, "is the central problem—how to help the American people get the most out of what they undertake. And this applies not only to industry and agriculture, but to government, public works, education, technical resistance, foreign aid—even to management itself. The management problem is productivity that assures the good use of every invested dollar."

Up to Management. He stated that management is challenged today to prove how efficient and good it is. Management is an overhead expense, and it must avoid permitting a bureaucracy to develop in an organization, because the dollars to sustain a bureaucracy become unproductive.

Also, our management people must meet with their colleagues in other countries, and be prepared to compete with the management of other nations. Meeting with their opposite numbers in other countries is perhaps the quickest way for men to acquire new dimensions in their thinking.

"Added to all our other problems," he said, "we have good reason to seek the means for making our country more productive in the use of all the advantages we enjoy. If we do this, the challenge will be met."

Engineers Joint Council Holds Annual Meeting in New York City

THE announcement of the resignation of E. Paul Lange as secretary of Engineers Joint Council was the first item of business at the Annual Meeting in the Statler Hilton Hotel, New York, N. Y., Jan. 22, 1960. Mr. Lange will become secretary of the American Institute of Industrial Engineers, Inc., whose headquarters—until the new United Engineering Center is completed—are in Columbus, Ohio. LeRoy K. Wheelock, a member of the staff of EJC, was named temporary secretary.

Enoch R. Needles, in his President's Report for 1959, spoke of the "continually expanding importance" of EJC and of the tremendous debt of gratitude owed "to those determined and consecrated pioneers who made possible this Council of today." He mentioned as significant evidence of the newer and stronger ties between engineering and science and the leaders in those fields at the national level, the election of Incoming EJC President Augustus B. Kinzel as chairman of the Division of Engineering and Industrial Research of the National Academy of Sciences.

UNESCO. C. S. Proctor, EJC Representative to UNESCO, reported that engineers are now being included on the technical missions of that organization, in recognition of the part that engineering plays in raising the standards of underdeveloped countries. Mr. Proctor, himself, headed an important UNESCO Conference on South American Affairs, held last summer. He pointed out that UNESCO flourishes to the extent that it receives support, and asked that the Founder Societies appoint an additional representative.

International Relations. G. A. Hathaway, Mem. ASME, chairman of the Committee on International Relations of EJC, announced the first Pan American Conference on Engineering Education would be held in Buenos Aires, Argentina, September 12–17, 1960. Ralph Morgan, President of Rose Polytechnic Institute, Terra Haute, Ind., and Chairman of the UPADI (Pan American Federation of Engineering Societies) Committee on Engineering Education, is arranging the program.

The conference will be followed by the Sixth UPADI Meeting, September 19–24, 1960, also at Buenos Aires.

The National Science Foundation is making a grant to EJC to make it possible for a delegation of eight educators to attend the Buenos Aires meeting. NSF has also made a grant to EJC for a delegation of six to visit Russia this summer to study and report on the education and utilization of engineers in that country. W. E. Lobo, Mem. ASME, chairman of the committee planning the trip, reported that Prof. John Turkevich of Princeton, who will be a special State Department Science Attaché at Moscow during President Eisenhower's trip to Russia, will serve as interpreter for the EJC Mission.

Under the sponsorship of EJC, NSF is bringing five visiting engineer lecturers from Europe this coming year, and appointments are now being made for them.

National Engineers Register. NSF has also entered into a $34,000 contract with EJC to explore the possibilities in respect to developing a new and complete National Engineers Register under the chairmanship of Harold Osborne. The next several months will tell what this Register should be, how it will be developed, and how best it may be utilized. The Register itself may involve two years of work and an outlay approaching $1 million.

Transportation. The National Transportation Policy Panel is now officially in existence and formal notification of this fact has gone to appropriate agencies in Washington. This panel consists of 21 engineers who are specialists from the major divisions of transportation represented by rail, highway, air, water, and pipeline. They are available to serve governmental agencies, upon invitation, in all phases of engineering involved in the changing aspects of transportation which are demanding closer attention at Washington.

Electronic Computers. The remarkable growth in the past five years in the adaptation of electronic computers to problem solving and data processing in the different fields of engineering has led to the proposal that leadership in these activities among the different societies should be headed up in Engineers Joint Council.

EJC Committee Structure. The Executive Committee of EJC was authorized to implement the necessary changes in the By-laws to revise the present committee structure of EJC. Groupings of standing, operating, task, and advisory committees will be established to clarify the functions of individual committees and to eliminate some overlapping. Name changes will be made in some cases, and a number of committees have been or will be eliminated.

A proposal to establish an American Engineers Association, Inc., has been approved by sufficient EJC member organizations, but not those belonging to ECPD. Viewed as an interim step toward unity, the organization would continue EJC and ECPD as parallel operating divisions with the Engineering Manpower Commission established as a third operating division. Since ECPD is named in many state laws, the continuation of the name as a division title would prevent any effect on these laws.

EJC Newsletter. The number of requests for *Engineer*, EJC's recently established newsletter, has been so great that 6000 copies had to be published. It now will be established as a full-fledged publication and be mailed directly to each of the 230,000 individuals in the 21 societies belonging to EJC. A $15,000 budget will permit either three or four issues to be published and distributed the first year.

Defense Research and Engineering. Herbert F. York, director of defense research and development for the Department of Defense, was guest speaker at the Dinner. He is director of all missile and space programs except those under civilian auspices. The current appropriation of $2.9 billion for missiles and

Herbert F. York, **left**, Director, Defense Research and Development, U. S. Department of Defense, principal speaker at the EJC annual meeting in New York City. Augustus B. Kinzel, **center**, 1960 EJC president, and Enoch R. Needles, 1959 EJC president, get some incite into Dr. York's ideas on defense research and engineering—the topic he later developed in his talk.

space (not including the $800 million civil space program) represents half of the Defense Department research budget.

Dr. York stated that the relationship of our program and that of the Russians could be summed up under two headings—timing and size. In brief, the biggest American rocket was one half the size of the Russians' and available about two years later.

Since the Russians were active in the field about four or five years earlier than we, the extent to which we have caught up is obvious. Although our thermonuclear program was in advance of theirs, we chose a 1-megaton size which would require a 360,000-lb thrust. Although they chose a bigger size, both countries were pessimistic. Our basic program would have led to a 600,000-lb rocket if carried through.

The Soviet rocket has an actual thrust between 600,000 and 800,000 lb, according to statistics.

From the point of missiles it was a good decision, Dr. York stated. The lower cost permitted twice as many to be built, and the mobility was better. In missiles, he said, the rule is "big enough and no bigger," whereas in space requirements it is "the bigger, the better." Our biggest rocket has yet to be used as a satellite launcher.

Military strategy was an important consideration in the developmental effort, since we had bases 1000 miles from Russian territory whereas they are 5000 miles from us. Because of this our efforts were concentrated on bomber development. Strategically we must be able to counter anything they can do, for its deterrent effect.

He stated that a great deal of simplification and streamlining of the research organization has taken place in the past year. The program has been divided largely on the basis of auxiliary requirements, since the way in which the new weapon fits into existing patterns of reconnaissance, warning, and defense determines whether it is primarily of interest to the Army, Navy, or Air Force. NASA has cognizance of all space research except that with military consequences.

American Power Conference Program Announced

A FORUM devoted to unconventional methods of generating power will be one of the features of the 22nd annual American Power Conference to be held March 29 through 31, at the Sherman Hotel, Chicago, Ill.

Research experts will discuss the fuel cell, the nuclear rocket program, isotopic heat and power, and magnetohydrodynamics. The Water Technology program will be announced at the meeting.

The three-day meeting will include about 95 papers and addresses covering all aspects of the power industry.

Conference director R. A. Budenholzer, Mem. ASME, of Illinois Institute of Technology, has announced that the All-Engineers dinner will be held on Wednesday, March 30.

More than 3000 industrial and electric-utility executives, engineers, educators, and government officials are expected to attend the conference which is sponsored by Illinois Tech in co-operation with a number of technical societies, of which The American Society of Mechanical Engineers is one, and educational institutions.

Sessions of most interest to mechanical engineers have been selected from the tentative program, and are as follows:

▶TUESDAY, MARCH 29

Registration 9:00 a.m.

Opening Meeting 10:00 a.m.

Joint APC-ASME Luncheon (sponsored by ASME) 12:15 p.m.

Chairman: *S. P. Kesios*, chairman, ASME Chicago Section

Co-chairman: *A. A. Fejer*, chairman, ME Dept., Illinois Inst. of Tech., Chicago, Ill.

Speaker: *W. L. Cisler*, ASME President

Subject: **An American Engineer in Russia**

Steam Generators 2:00 p.m.

Predicting Tube Life in High-Temperature Boiler Installations, by *J. L. Menson*, Combustion Engineering Co., New York, N. Y.

Nuclear Heated Boilers, by *R. C. Barnett* and *Norval McDonald*, The Babcock & Wilcox Co., Barberton, Ohio

Some Aspects in the Control and Interlocking of a Gas-Fired Boiler-Turbine-Generator Unit, by *E. H. Finch* and *L. Skog, Jr.*, Sargent & Lundy Engineers, Chicago, Ill.

Some Applications of the Low Level Economizer, by *J. H. Potter*, Stevens Inst. of Tech., Hoboken, N. J.

Turbine Generators 2:00 p.m.

Operating Experience With Conductor-Cooled Turbine-Generators, by *L. M. Abrahamson*, Wisconsin Power and Light Co., Madison, Wis.; and *L. T. Rosenberg*, Allis-Chalmers Mfg. Co., Milwaukee, Wis.

Four Years' Operating Experience With Large Liquid-Cooled Turbine-Generators, by *C. E. Kilbourne* and *C. H. Holley*, Gen. Elec. Co., Schenectady, N. Y.

Operating Experience With Inner Cooled Turbine-Generators, by *O. K. Brown*, Niagara Mohawk Power Corp., Buffalo, N. Y.; and *J. W. Batchelor*, Westinghouse Elec. Corp., East Pittsburgh, Pa.

Space Heating 2:00 p.m.

Chairman: *D. H. Madsen*, Associate Professor of Mechanical Engineering, State Univ. of Iowa, Iowa City, Iowa.

Co-Chairman: *Lois Graham*, Assistant Professor of Mechanical Engineering, Illinois Inst. of Tech., Chicago, Ill.

Solar Energy for Future Heat Pumps, by *E. B. Penrod*, Univ. of Kentucky, Lexington, Ky.; and *K. V. Prasanna*, Illinois Inst. of Tech., Chicago, Ill.

Methods for Evaluating Heat Losses in Concrete Slabs, by *M. A. Chasseyka*, Armour Research Foundation; and *S. P. Kesios*, Illinois Inst. of Tech., Chicago, Ill.

Fuel Cell Tractor and Electric Auto 3:30 p.m.

Chairman: *D. J. Renwick*, Associate Professor of Mechanical Engineering, Michigan State Univ., East Lansing, Mich.

The Fuel Cell Tractor, by *W. Mitchell, Jr.*, Allis-Chalmers Mfg. Co., Milwaukee, Wis.

The Electric Auto, by *C. R. Erickson*, Board of Water and Light, Lansing, Mich.

Industrial Plants—Industrial Power-Plant Safety 3:30 p.m.

Chairman: *K. R. Hodges*, chief engineer, Sears Roebuck & Co., Chicago, Ill.

Flame Failure Protection for Industrial Boilers, by *H. Christiansen*, Electronics Corp. of America, Chicago, Ill.

Power-Plant Safety, by *W. C. Kramer*, Commonwealth Edison Co. of Indiana, Hammond, Ind.

Evening General Interest Session 8:00 p.m.

Advanced Engineering Concepts

Magnetohydrodynamic Power, by *A. Kantrowitz*, Avco-Everett Research Lab., Everett, Mass.

Isotopic Heat and Power, by *W. W. T. Crane*, The Martin Co., Baltimore, Md.

Nuclear Rocket Program—Where It Is and Where It Is Going, by *H. R. Schmidt*, Aircraft Reactors Branch, Division of Reactor Development, Washington, D. C.

Fuel Cells, by *Everett Gorin*, Pittsburgh Consolidation Coal Co., Pittsburgh, Pa.

▶WEDNESDAY, MARCH 30

Power Generation for Peak Loads (sponsored by ASME Power Division) 9:00 a.m.

New Generation Concepts and How They May be Applied, by *W. D. Marsh* and *A. G. Mellor*, Gen. Elec. Co., Schenectady, N. Y.

How Shall We Meet Peaking Requirements? by *L. B. LeVesconte* and *Tor Kolflat*, Sargent & Lundy, Engineers, Chicago, Ill.

Economics of Peaking, by *F. A. Ritchings*, Ebasco Services Inc., New York, N. Y.

The Economics of a 22,000-Kw Peaking Gas Turbine, by *J. O. Stephens*, Philadelphia, Pa.; and *B. L. Lloyd*, Westinghouse Elec. Corp., East Pittsburgh, Pa.

APC-AIEE Luncheon (sponsored by the American Institute of Electrical Engineers) 12:15 p.m.

Chairman: *J. H. Foote*, AIEE President

Co-Chairman: *Francis Cox*, chairman, Chicago Section AIEE

Large Steam Turbines (sponsored by ASME Power Division) 2:00 p.m.

Economics of Very Large Turbine Generators, by *J. R. Carlson*, Westinghouse Elec. Corp., Philadelphia, Pa.

Large Steam-Turbine-Generators With Spinning Reserve Capacity, by *J. E. Downs* and *E. H. Miller*, Gen. Elec. Co., Schenectady, N. Y.

Factors Influencing the Reliability of Large Steam-Turbine-Generator Units, by *C. D. Wilson*, Allis-Chalmers Mfg. Co., Milwaukee, Wis.

Fuels (sponsored by ASME Fuels Division) 2:00 p.m.

Slag-Tap Boiler Performance Associated With Power-Plant Flyash Disposal, by *H. M. Rayner*, Western Elec. Co., Inc., Chicago, Ill.; and *L. P. Copian*, Riley Stoker Corp., Worcester, Mass.

Measurement of Density and Moisture in Large Coal Storage Piles, by *A. S. Grimes*, American Elec. Power Service Corp., New York, N. Y.

The Factory-Fabricated Coal-Fired Boiler, by *L. F. Deming*, Power Generation Branch, U. S. Navy, Bureau of Yards and Docks, Washington, D. C.

All Engineers Dinner 6:30 p.m.

▶THURSDAY, MARCH 31

Nuclear Power 1 9:00 a.m.

Progress Report on the Dresden Nuclear Power Plant, by *V. D. Nixson*, Gen. Elec. Co., and *J. J. Poer*, Commonwealth Edison Co., Chicago, Ill.

Economic Nuclear Power—When?, by *W. L. Budge*, Westinghouse Elec. Co., Pittsburgh, Pa.

Superheated Steam From Nuclear Energy, by *C. R. Braun* and *C. B. Graham*, Allis-Chalmers Mfg. Co., Chicago, Ill.

Central Station Plants and Auxiliaries 9:00 a.m.

Problems in the Design of Concrete Chimneys, by *D. O. Thompson*, Commonwealth Edison Co.; and *Max Zar*, Sargent & Lundy, Engineers, Chicago, Ill.

Selection of Boiler Feed-Pump Drive for 250-Mw Turbine-Generator Unit, by *J. C. Beres* and *R. W. Potts*, Commonwealth Associates, Inc., Jackson, Mich.

Mechanical Draft Fans in the Future—Critical Areas in Application, by *W. E. Wendover*, American Standard Industrial Div., Detroit, Mich.

Structural Stability of Commercial Wrought Austenitic Steel for 1150 to 1450 F Power-Plant Piping, by *E. A. Sticha*, Edward Valves, Inc., East Chicago, Ind.

Industrial Plants 1 9:00 a.m.

A Generalized Computer Program for Evaluating Industrial Turbine Performance, by *A. J. Klomparens* and *R. W. Hermanson*, Dow Chemical Co., Midland, Mich.

Novel Features of a New Central Power Plant to Replace Four Separate Plants, by *H. H. Reisman*, Deere & Co., Moline, Ill.

Pond Surface Cooling for Chemical Plant Cooling Water, by *Bruce Bardin* and *Alex Regan*, Union Carbide Chemicals Co., Seadrift, Texas

System Planning and Operation 9:00 a.m.

Chairman: *Nathan Cohn*, vice-president, Technical Affairs, Leeds and Northrup Co., Philadelphia, Pa.

Co-Chairman: *M. Rias*, professor of electrical engineering, Univ. of Minnesota, Minneapolis, Minn.

New Tools Improve System Generation Planning, by *C. D. Galloway* and *L. K. Kirchmayer*, Gen. Elec. Co., Schenectady, N. Y.

Operational Gaming and the Use of Mathematical Models for Developing System Economics and Planning, by *C. J. Baldwin*, Westinghouse Elec. Corp., East Pittsburgh, Pa.; and *C. H. Hoffman*, Public Service Electric and Gas Co., Newark, N. J.

Closing the Computer Loop on System Regulation, by *W. J. Brogden*, Carolina Power and Light Company, Raleigh, N. C.

Progress in Automation of Electric Power System Planning and Operation, by *C. Concordia* and *F. J. Maginniss*, Gen. Elec. Co., Schenectady, N. Y.

Industrial Plants 2 10:30 a.m

Chairman: *H. H. Foreman*, president, National Association of Power Engineers

Ash-Handling Systems for Industrial Power Plants, by *A. M. Perrin*, National Conveyors Company, Inc., Bergen County, N. J.

Combustion of Residual Fuel Oils, by *D. S. Frank*, Pure Oil Co., Chicago, Ill.

Factors to Consider in the Application of Centrifugal Pumps, by *R. E. Allen*, Ingersoll-Rand Co., New York, N. Y.

Joint APC-WSE Luncheon (sponsored by Western Society of Engineers) 12:15 p.m.

Chairman: *J. T. Rettaliata*, president, Western Society of Engineers, and president, Illinois Inst. of Tech., Chicago, Ill.

Speaker: *A. S. King*, president, Northern States Power Co., Minneapolis, Minn.

Subject: **The Challenge of the Power Industry.**

Nuclear Power 2 2:00 p.m.

Gas-Graphite Suspension-Cooled Reactor, by *G. K. Rhode*, *D. C. Schluderberg*, *E. E. Walsh*, and *D. M. Roberts*, The Babcock & Wilcox Co., Lynchburg, Va.

The Liquid Fluidized Bed Reactor, by *M. R. Schere*, The Martin Co., Baltimore, Md.

Process Heat Reactors for Industry, by *Frank Pitman*, Division of Civilian Application, AEC, Washington, D. C.

Conditions Conducive to Originality Needed to Speed Research Goals, Say Authorities

Scientific and technological advance could be speeded if this country's research and development were conducted under conditions which would stimulate greater originality.

This is the reported answer given by 51 of the nation's top scientists, researchers, and educators, who conferred for two days last December at Worcester Polytechnic Institute under auspices of the National Science Foundation in co-operation with 15 leading scientific and engineering societies, including The American Society of Mechanical Engineers. ASME was represented by Fenton B. Turck, Fellow ASME, and Donald H. Cornell, Mem. ASME.

They pondered the thought that research people too easily become pre-occupied with goals of relatively small dimensions which promise little in significant discovery, and that progress will be influenced far more by those who can strike out with vigor and vitality for breakthroughs on the frontiers of science.

They pointed out that the young researcher is steered in the direction of conservatism by his education, research support, professional societies, as well as social and cultural environment.

These tendencies, they said, serve to produce small steps in the extensions of knowledge. More rapid and efficient progress, they said, might reasonably be expected if greater encouragement were to be given for more young people to leap-frog for the distant goals.

Recommendations to Colleges and Universities

1 Develop educational programs which require the student to exercise a high degree of originality and independence of thought. The student should be challenged with creative experiences throughout his educational experience.

2 Bring talented youth into stimulative personal association with leading scientists and engineers.

3 Doctoral research should encourage more venturesome attitudes. A graduate student should not necessarily be penalized by failure to complete distant objectives.

4 Develop institutional policies which provide an encouraging environment for venturesome research. This starts with faculty members who themselves are creative.

5 Develop closer liaison between college, industrial, and governmental research organizations.

6 Encourage undergraduate and graduate students who have novel, creative ideas to pursue the development of these ideas and help them to obtain financial support.

Recommendations to Scientific and Engineering Societies

1 Establish more effective practices to increase the attendance and participation of young members at meetings

of scientific and engineering societies.

2 Encourage the presentation and publication of philosophical papers which look to the future of science and technology.

3 Develop comprehensive programs for digesting research knowledge.

4 Establish society meetings to develop more effective interchange of ideas between scientists and engineers in research areas of broad mutual interest.

5 Establish free forums at engineering society conventions where any member may make a short presentation of his creative work.

6 Actively promote and encourage financial support for research.

7 Foster among society members a recognition of the contribution which they can make by stimulating at an early age the creative development of youth.

And it Was Further Suggested

The report contained a statement that "our nation's colleges and universities can be our most powerful instruments for progress. But they can perform their essential function only if they have financial support adequate to sustain a high level of research activity."

It further pointed out that "excessive diversion of basic research funds to noneducational laboratories at the expense of providing adequate research funds for colleges and universities could destroy the creative vitality of our colleges and universities."

The report urged the scientific and engineering societies to take the initiative in bringing together leaders in education, industry, and government to study the problems of large-scale research. It said, "It is imperative such studies be approached, not in the framework of preconceived ideas and the preservation of tradition, but rather with a fresh, new, and objective outlook."

It was signed by Arthur B. Bronwell, Mem. ASME, President of Worcester Polytechnic Institute; and the Conference Report Committee composed of the following: Harvey Brooks, Dean of Engineering and Applied Physics, Harvard University; Carl C. Chambers, Vice-President, University of Pennsylvania; Edward U. Condon, Chairman, Department of Physics, Washington University; Lee DuBridge, President, California Institute of Technology; Richard G. Folsom, Fellow ASME, President, Rensselaer Polytechnic Institute; Linton Grinter, Mem. ASME, Dean of Graduate School and Director of Research, University of Florida; John Hollomon, Associate Director of Research, General Electric Company; John H. Rushton, Department of Chemical Engineering, Purdue University; Gerald F. Tape, Department Director, Brookhaven National Laboratory; B. Richard Teare, Jr., Dean of College Engineering and Science, Carnegie Institute of Technology; and Benjamin A. Wooten, Associate Professor of Physics, Worcester Polytechnic Institute.

U. S. Group Announces Plans for Participation in World Power Conference Session in Spain, June 5-9

THIRTEEN technical papers relating to methods of solving power-shortage problems have been submitted by United States Representatives for the 13th biennial section meeting of the World Power Conference to be held in Madrid, Spain, June 5–9, 1960.

Sponsor. The papers were sponsored by the United States National Committee, which held its annual meeting in Washington, D. C., January 19. The U. S. group is one of 55 national committees from all over the world making up the membership in the World Power Conference, a nongovernment international organization with headquarters in London, England. In addition to the biennial sectional meetings, plenary sessions are held once every six years.

Theme of Conference. Using the subject "Methods of Solving Power Shortage Problems," the general theme of the Madrid conference will stress the long-term rather than short-term supply of a country's energy needs. This principal theme will be discussed under subdivisions dealing with methods of investigation of energy sources and requirements, efficiency of production and utilization of energy, technical developments in transportation of fuels and transmission of electrical energy, establishment of nuclear reactors on an industrial scale, and functional interrelation between conventional and nuclear production of energy.

At the January 19 meeting, the U. S. National Committee announced that the 13 technical papers submitted by its representatives cover the entire range of subdivisions of the conference theme. These papers and their authors are listed as follows:

Methods of Evaluating Sources and Requirements for Solid and Liquid Fuels in the United States, by *C. C. Anderson* and *T. W. Hunter*, Branch of Bituminous Coal Economics and Statistics, Bureau of Mines, U. S. Department of the Interior

Methods of Investigating Hydroelectric Energy Potential on Multiple-Purpose Reclamation Projects, by *F. E. Dominy*, Commissioner, Bureau of Reclamation, U. S. Department of Interior

Forecasting Electric-Power Requirements and Generating Facilities, by *A. S. Griswold* and *F. D. Campbell*, The Detroit Edison Co.

Thirty Years of Development in Improving Efficiency and Reducing Costs of Thermoelectric Generation of Electric Energy, by *Philip Sporn*, Hon. Mem. ASME, and *S. N. Fiala*, both of American Electric Power Service Corp.

Operations Research Study of Peaking Power Economics, by *J. K. Dillard*, Westinghouse Elec. Corp.

Passamaquoddy—Harnessing Tidal Power for Energy, by *J. W. Leslie*, Engineering Div., New England Div. U. S. Corps of Engineers

Transportation and Storage of Gaseous Fuels, by *K. B. Nagler*, The Peoples Gas, Light and Coke Co.

The Development of Commercially Practical Nuclear Power Reactors, by ASME President *W. L. Cisler*, The Detroit Edison Co.

Technological and Economic Factors Affecting the Rate of Development of Nuclear Power in the United States, by *E. T. Hughes* and *N. C. Nelson*, Bureau of Power, Federal Power Commission

EHV Systems in the Progress of the Electric-Utility Industry of the U. S. A., by *P. A. Abetti* and *I. B. Johnson*, Gen. Elec. Co.

Nuclear Power Application Other Than Central Station Power, by *F. E. Pittman*, Reactor Development Div., U. S. AEC

Nuclear Fuel Resources and Reactor Fuel Costs, by *W. H. Zinn*, Combustion Engineering, Inc.; and *J. R. Dietrich*, Gen. Nuclear Engng Corp.

Base Load Nuclear Power Plants in an Integrated Hydroelectric and Thermal Electric-Power System, by *C. C. Whelchel*, Pacific Gas and Elec. Co.

New Officers. The U. S. Committee, which is managed by an executive board of nine members, also announced the election of its officers to serve for the ensuing year. They are: Francis L. Adams, chief, Bureau of Power, Federal Power Commission, Chairman; J. N. Landis, past-president and Fellow ASME, vice-president, Power Division, Bechtel Corporation, Vice-Chairman; and Brig. Gen. Stewart E. Reimel, USA (Ret.), Mem. ASME, Secretary.

Format of Meeting. The technical papers will be printed and distributed to each registrant several months in advance of the Madrid conference date so that the session may be conducted on a discussion, or workshop basis, rather than with formal presentations of the complete papers. There also will be postconference tours including visits to power installations, industrial plants, and points of interest throughout Spain. In addition to the sessions and tours the Spanish Committee also has made plans for a number of social events. The U. S. Committee has made arrangements with Thomas Cook and Sons to serve as its travel agent.

How to Register. All participants in meetings of the World Power Conference must register through their National Committee. U. S. participants should write to the United States National Committee for registration forms, which must be returned to the Secretary with the $50 registration fee. The Secretariat for the U. S. Committee is furnished through the Engineers Joint Council, 29 West 39th Street, New York 18, N. Y. All communications should be addressed to the Secretary, U. S. National Committee, World Power Conference, at that address.

World Power Conference Founded. Formed in 1924, the World Power Conference is one of the oldest international technical organizations. Objectives: The development and peaceful use of energy resources to the greatest benefit of all, both nationally and internationally by (1) considering the potential resources and all the means of production of energy in all their aspects; (2) collecting and publishing data on energy resources and their utilization; and (3) holding conferences of those concerned in any way with surveying, developing, or using energy resources. The Conference's International Executive Council has central offices at 201 Grand Buildings, Trafalgar Square, London, England. Sir Vincent de Ferranti, Hon. Mem. ASME, of England, is present chairman of the International Council, which meets annually at various cities of the world to carry on the continuing business of the organization.

View of Madrid, Spain, shows monument to Miguel Cervantes on the Plaza Espana. Rear, the España Building and the Torre de Madrid, left.

United States Committee. The U. S. Committee is composed of three major groups of participating members. They are: (1) The professional engineering Societies, currently including the American Society of Civil Engineers, the American Institute of Mining, Metallurgical and Petroleum Engineers, The American Society of Mechanical Engineers, the American Institute of Electrical Engineers, and the American Institute of Chemical Engineers; (2) the industrial, utility, or similar associations, comprised of the Association of Edison Illuminating Companies, Edison Electric Institute, and American Gas Association; and (3) the federal and state government bodies, composed of the Atomic Energy Commission, Federal Power Commission, Bureau of Mines and Bureau of Reclamation of the Department of the Interior, the U. S. Army Corps of Engineers, and the Department of Agriculture's Rural Electrification Administration.

For Further Information. Write: Francis L. Adams, Chief, Bureau of Power, Federal Power Commission, Washington, D. C.; and Brig. Gen. Stewart E. Reimel, World Power Conference, 29 West 39th Street, New York 18, N. Y.

PEOPLE

Honors and Awards. Clarence B. Campbell, Fellow ASME, has been selected to receive the Gold Medal of the Newcomen Society in North America "in consideration of his many outstanding achievements in the utilization of steam for the benefit of mankind." The award was presented at the society's annual dinner at Franklin Hall of The Franklin Institute, Philadelphia, Pa., January 14.

Wilfred Sykes, Fellow ASME, is one of five men named honorary members of the AIME. Mr. Sykes has been cited for his service to the steel industry.

Raymond D. Mindlin, Mem. ASME, received one of the annual Great Teachers Awards of the Society of Older Graduates of Columbia University. Professor Mindlin had been honored previously for his work in developing the radio proximity fuse.

John Boyd, Mem. ASME, has been named the recipient of the 1960 ASLE National Award. The award will be presented at the Society's 1960 annual banquet to be held in Cincinnati, Ohio, on April 20, Netherland Hilton Hotel.

Hilliard W. Paige, one of the nation's outstanding space technology experts, has been named Philadelphia area's "Engineer of the Year" for 1960.

James A. Van Allen received the Hill Space Award of the Institute of the Aeronautical Sciences. Presentation was made at the society's annual honors night dinner at the Astor Hotel, New York, N. Y., January 26.

J. F. Fairman, senior vice-president, Consolidated Edison Company, received the AIEE Edison Medal "for outstanding

Twelve-man Japanese Chemical-Industry Fire Prevention and Safety Team is on a six-week tour to study chemical installations and safety practices in the United States. They are traveling under the auspices of International Co-operation Administration. Laurence Williams, project manager, Processes and Techniques Studies Branch, Office of Industrial Resources, ICA, and two interpreters are accompanying the team. After being welcomed by O. B. Schier, II, secretary, ASME, on February 1, the group heard J. C. Wilding, assistant secretary, ASME, point out the importance of equipment in the prevention of fire and accidents and the usefulness of codes such as the ASME Unfired Pressure Vessel Code and the Code for Pressure Piping in sound chemical-plant construction.

performance in improving the design of large electric power systems; for far-sighted leadership in atomic power development; and for unremitting efforts to improve the engineering profession."

The AIEE John Scott Medal was presented to Dean A. Lyon, Woodbridge, Conn., in recognition of his invention of the method of producing the first practically useful optical coatings for the reduction of light reflections.

Clarence H. Linder, Mem. ASME, has been named president of the American Institute of Electrical Engineers for 1960–1961. Announcement was made at the winter general meeting of the AIEE in the Statler Hilton, New York, N. Y.

New Appointments. E. A. Allcut, Fellow ASME and member of the Power Test Codes Committee, has been appointed by the Government of Ontario as a Commissioner of the Ontario Fuel Board.

F. K. McCune, Mem. ASME, internationally known for his work in atomic energy, has been appointed vice-president—Engineering Services for the General Electric Company. In his new post Mr. McCune will be concerned with effective direction of the effort and use of General Electric's extensive engineering resources, which include some 13,500 company engineers.

Leslie A. Runton, Mem. ASME, has been elected president of Timely Clothes, Inc., Rochester, N. Y. Mr. Runton was formerly president of Russell Manufacturing Company, a Middletown, Conn., textile firm.

Titus G. LeClair has been appointed manager of nuclear power applications for General Dynamics Corporation's General Atomic Division. In addition to his work on task forces and committees of the AEC and the Joint Congressional Committee, he recently served as chairman of a committee established by the Atomic Industrial Forum to develop procedures for use by the Government and the electric-generating industry in evaluating nuclear power reactors. Because of his national prominence in the engineering field, he has served as president of several professional societies, including the Engineers Joint Council, the Illinois Engineering Council, Western Society of Engineers, and American Institute of Electrical Engineers. He also has been vice-president of the American Nuclear Society and is a member of the National Society of Professional Engineers.

Brian P. Emerson, Mem. ASME, veteran editor of *Diesel Power* and one of the most respected authorities in the entire diesel engine industry, has been elected vice-president of Diesel Publications, Incorporated. In addition to heading up the *Diesel Power* editorial staff, Mr. Emerson has also written or edited several of the textbooks on diesel engines and accessory equipment published by Diesel Publications, Incorporated. Just recently, Mr. Emerson has been appointed to the editorship of the new *Gas Turbine* magazine published by a subsidiary of Diesel Publications, Incorporated.

Campus Data. Leslie Silverman, Mem. ASME, professor of engineering in environmental hygiene and director of the radiological hygiene program of the Harvard University School of Public Health, has been elected chairman of the Atomic Energy Commission's Advisory Committee on Reactor Safeguards.

Edwin S. Burdell, the president of the Cooper Union for the Advancement of Science and Art, was retired with the title of president-emeritus on February 29. Mr. Burdell will become president of the Middle East Technical University of Ankara, Turkey.

Alfred C. Ingersoll, civil engineer who has been on the faculty of the California Institute of Technology, will become dean of the School of Engineering, University of Southern California.

Retirement. Newton Dana Cook, for 34 years manager of the San Francisco Office, Engineering Societies Personnel Service, Inc., has announced his retirement. Mr. Cook during his long service to engineers in his community has assisted more than 8000 engineers to find jobs and thousands of employers to fill vacant positions.

"Where are they now?" *Newsweek* in its November 23, 1959, number asks the question about John C. Garand and Carl L. Norden, both ASME Holley Medalists. Mr. Garand, inventor (in 1933) of the M-1 semiautomatic rifle which was the mainstay of the U. S. infantryman in World War II, lives with his wife near the U. S. Army Springfield Armory where he worked for 35 years until his retirement in 1953. The new M-14 rifle soon to replace the M-1 is a modification of a never-produced weapon which Mr. Garand designed just after World War II. "The Periscope" also sights on Carl L. Norden. Mr. Norden is the inventor and manufacturer of a bombsight which pinpointed targets in nearly every large-scale bombing attack made by the U. S. in World War II. He is now living with his wife just outside of Zurich, Switzerland.

Maurice J. Zucrow, Fellow ASME, is among six members of the Purdue University faculty to be honored for "Distinguished Professorship." He has been named Atkins Professor of Engineering and will be in charge of instruction and research in the fields of gas turbines and jet propulsion. A specialist in these fields, Dr. Zucrow has been called upon to serve as a committee member and consultant for both NACA (now NASA) and the Department of Defense. He has recently been appointed a member of an advisory panel to the Committee on Science and Astronautics of the House of Representatives.

Grant. The first research grant under the Exchange and Training Programme of the International Atomic Energy Agency (IAEA) has been awarded to Dr. R. P. Agarwala of India. It is planned that Dr. Agarwala will undertake 12 months' research in the field of solid-state physics and chemistry at the Massachusetts Institute of Technology.

Died. H. W. B. Skinner, head of the department of physics, Liverpool University, U. K., and a prominent leader in the development of the European Organization for Nuclear Research (CERN). He acted as chief consultant in the designing and building of CERN's 600-million electronvolt synchro-cyclotron. At the time of his death, he had been in Geneva to take part in a meeting of European physicists to discuss the future experimental research program of the CERN 25-thousand-million electronvolt proton synchrotron.

COMING MEETINGS

Symposium on Plasticity

The second symposium on naval structural mechanics will be held April 5-7, 1960, at Brown University, Providence, R. I., under the joint sponsorship of the Office of Naval Research, Department of the Navy, and of Brown University. The Symposium will be devoted exclusively to the field of plasticity. The program will consist of critical surveys in selected areas and of reports on original research, with ample time for discussion.

NSF Funds to Encourage Participation in International Congresses

Limited funds are available from the National Science Foundation for the support of travel by American scientists to international scientific congresses. An attempt will be made to have the grants approximate round-trip air-tourist fare between the recipient's home institution and the location of the meeting. The following congresses have been selected for support:

1 First Congress of International Federation of Automatic Control in Moscow, USSR, June 25-July 9, 1960. Application forms available from: Div. of Math., Phys., and Eng. Sci., NSF, Washington 25, D. C. Closing date: March 31, 1960.

2 Tenth International Congress of Applied Mechanics, IUTAM, in Stresa, Italy, Aug. 31-Sept. 7, 1960. Application forms available from: Div. of Math., Phys., and Eng. Sci., NSF, Washington 25, D. C. Closing date: May 1, 1960.

MEETINGS OF OTHER SOCIETIES

March 14-18

NAM, institute on industrial relations, Hollywood Beach Hotel, Hollywood, Fla.

March 14-18

National Association of Corrosion Engineers, annual conference and 1960 corrosion show, Dallas, Texas.

March 15-17

SAE, national automobile meeting, Sheraton-Cadillac Hotel, Detroit, Mich.

March 21-23

AMA, forum on administrative work measurement, Biltmore Hotel, New York, N. Y.

March 21-24

IRE, international convention, Waldorf Astoria Hotel and Coliseum, New York, N. Y.

March 23-24

ISA, annual iron and steel conference, Pick-Roosevelt Hotel, Pittsburgh, Pa.

March 23-25

ARS, ground support equipment conference, Statler-Hilton Hotel, Detroit, Mich.

March 24-25

Textile Research Institute, annual meeting, Commodore Hotel, New York, N. Y.

March 28-29

The Material Handling Institute, Inc., Pittsburgh Hilton Hotel, Pittsburgh, Pa.

April 3-8

Nuclear Engineering and Science Conference co-ordinated by EJC and sponsored by 30 major engineering societies, Coliseum, New York, N. Y.

April 4-7

AMA, national packaging conference and exposition, Convention Hall, Atlantic City, N. J.

April 4-8

AGARD-NATO, combustion and propulsion panel, high Mach number air-breathing engines, Milan, Italy.

April 6-8

Institute of Environmental Sciences, national meeting, Biltmore Hotel, Los Angeles, Calif.

April 19-21

ASLE, annual meeting, Netherland Hilton Hotel, Cincinnati, Ohio.

April 24-May 3

Hanover Fair, German Industries Fair, Hanover, Germany.

(*For ASME Coming Events, see page 131*)

Papers for Eighth Hot Laboratory and Equipment Conference

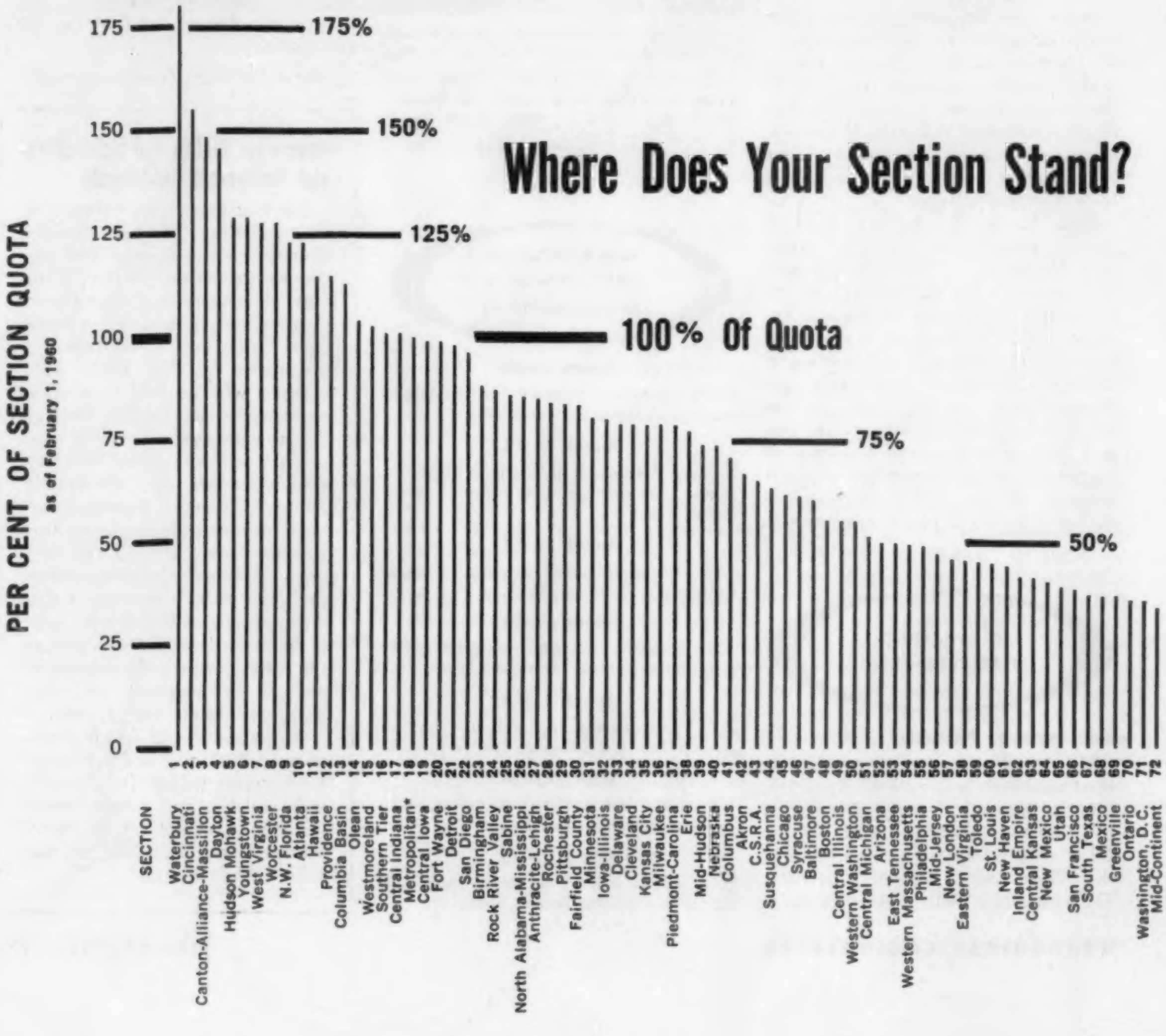
The Hot Laboratory Division of the American Nuclear Society announces that summaries of papers to be submitted for the Eighth Hot Laboratory and Equipment Conference to be held in San Francisco, Calif., Dec. 11-14, 1960, are due before May 16, 1960. This meeting will be held simultaneously with the American Nuclear Society winter meeting and in conjunction with the nuclear industry exhibit and meeting of the Atomic Industrial Forum. Persons interested in submitting papers for this meeting should contact the Program Chairman: James R. Lilienthal, Los Alamos Scientific Laboratory, P. O. Box 1663, Los Alamos, N. Mex., for information regarding the form in which the summaries are to be prepared. Accepted papers will be due Sept. 1, 1960.

Papers are invited on all phases of hot laboratories and equipment for handling radioactive material, such as design and construction of facilities and equipment, dry boxes, manipulators, shielding, operations, costs, and so on.

United Engineering Center

Excavation on the east side of the United Engineering Center site at 845 United Nations Plaza in New York City has been completed and installation of reinforced forms is well advanced. **Above,** contractors' representatives watch as concrete fills first form.

Where Does Your Section Stand?

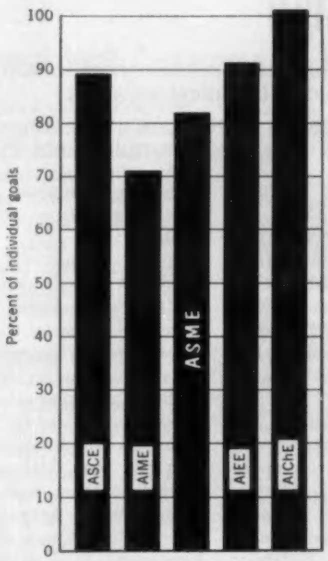


Actual construction began on the United Engineering Center on Feb. 2, 1960, as this first batch of concrete poured into form No. 65, first segment of the structure's footing. One of a series of new Midtown Manhattan buildings, the Center is due for completion in 1961.

On the western portion of the United Engineering Center site, where a subbasement will house mechanical and electrical equipment, blasting and excavation continued. After having cleared loose surface soil, contractors are now blasting through Manhattan trap rock.

How IS ASME Doing?

United Engineering Center Building Fund Member Gifts Campaign status as of Feb. 5, 1960



Action in the Homestretch

Two more ASME Sections have reached their goals and two others have made major strides to attain positions near the top as ASME drives to complete "Operation Homestretch," the final phase of its Member Gifts Campaign. The Society has now moved to within 18.4 per cent of its quota.

The new Sections topping the 100 per cent mark are Southern Tier, with 102.5 per cent—up 7.3 per cent in January—and the largest of them all, the Metropolitan Section, which has reached 100.1 per cent with a 3.1 per cent boost in the same period.

Pushing hard toward the goal are Detroit, which recorded a 14.8 per cent gain to make 98.9 per cent of its total, and San Diego, which rang up an impressive 11.2 per cent to reach 95.9 per cent.

These four and the other 88 ASME Sections have a combined total of 81.6 per cent of quota, reflecting the interest and hard work of many local and national Member Gifts workers. Analysis of the figures points up, however, the minority of lagging Sections that are holding ASME back from its goal. This is in spite of the fact that some which have already far exceeded their quota are still making gains. Example: Hudson-Mohawk, whose members made enough additional gifts to move them up to 130.6 per cent of their promised total.

Meanwhile, work continues on the United Engineering Center. Construction of the forms for concrete was begun in January, and on February 2 the first batch of concrete for the foundation was poured.

Notes on
Society Activities
and Events

E. S. NEWMAN
News Editor

THE ASME NEWS

ASME Design Engineering Conference and Design Engineering Show to Highlight New Horizons in Engineering Design

- New design principles, relationships, and formulas to be discussed in technical sessions
- Design Engineering Show—one of the largest industrial shows of its kind—complements the discussions

THEY GO hand in glove: The Design Engineering Conference, sponsored by the Machine Design Division of The American Society of Mechanical Engineers, and the Design Engineering Show, produced by the exposition management firm of Clapp & Poliak, Inc., of New York. Both will be presented concurrently at the New York Coliseum, May 23–26.

New design principles, relationships, and formulas are being developed daily as the nuclear and space age enters its decisive decade. Many of the newer materials, fabrication methods, changing concepts, and improvement performance factors researched and developed specifically for reactors and space flight have a direct bearing on the commercial products being designed today and a far-reaching effect on what will emerge tomorrow from the research and development installations around the world.

The Conference

To keynote these horizons, a panel of design authorities in nuclear and space technology will, by brief talks and answers to questions, show how the field of design may be changed. Members on the opening day panel of the Design Engineering Conference will include: Hugh L. Dryden, Fellow ASME, of NASA; Arthur Kantrowitz, Avco-Everett Laboratory; William R. Gall, Mem. ASME, Oak Ridge National Laboratory; Varick Schwartz, Assoc. Mem. ASME, Combustion Engineering, Inc.; George Sutton, Mem. ASME, ARPA of the Department of Defense; and Elmer Wheaton of Douglas Aircraft.

Concurrent sessions on Tuesday and Wednesday will extend the remarks of the panel in practical engineering applications. Sessions will cover such diverse topics as reliability, control systems, material fabrication, high-strength metals and composite materials, hydraulic components and fluids, and mechanized assembly. In each session a question-and-answer period will follow paper presentation where general and specific problems may be discussed.

Where and how computers can be used in engineering will be the subject of the final Conference session on Thursday. A panel of engineering uses will discuss the problem of scheduling and integrating computer sections into the over-all engineering setup; types of machines available and those which should be used for specific problem areas; cost on installation and operation; and the training of personnel.

The Show

Clapp & Poliak, Inc., producers of the extremely successful Design Engineering Show, report a growing registration of the nation's leading companies engaged in this field so that this year's show will once again be listed as "one of the largest industrial expositions in the country."

In the past, although admission is limited to those with major responsibilities for the design of new products, more than 20,000 executives and engineers have attended. This year, since the show includes materials and component parts for virtually every type of product whether it be commonplace household articles or interplanetary space ships, it is anticipated that every major manufacturing company in the nation will be sending representatives. To be prepared to accommodate the thousands expected at the show, all four floors of the New York Coliseum have been reserved.

Vital Statistics. The conference begins at 9:00 a.m. and ends at noon each day; the show is held in the afternoon—one

1960 RAC Meetings Schedule

Date	Days	Location	Hotel	Region	Section
April 9–10	Sat-Sun	Columbia, S. C.	Columbia	IV	CSRA
April 11–12	Mon-Tue	Syracuse, N. Y.	Syracuse	III	Syracuse
April 20–21	Wed-Thur	Mexico, D. F.	Continental Hilton	VIII	Mexico
April 1–2	Fri-Sat	Los Angeles, Calif.	Disneyland	VII	Los Angeles
April 25–26	Mon-Tue	Cincinnati, Ohio	Carrousel	V	Cincinnati
April 29–30	Fri-Sat	Minneapolis, Minn.	Normandy	VI	Minnesota
May 2–3	Mon-Tue	Garden City, L. I.	Garden City	II	Metropolitan
May 6–7	Fri-Sat	New London, Conn.	Mohican	I	New London
Palm Sunday	April 10				
Good Friday	April 15				
Easter Sunday	April 17				

does not conflict with the other. Visitors who register for the ASME Conference automatically are admitted to the Design Engineering Show; thus in the morning one learns how, in the afternoon one sees how.

Registration for the Design Engineering Show is $2; Conference fee is $5 for ASME members and related engineering societies, or $10 for nonmembers. Conference registration not only entitles you to attend the technical sessions and the show, but to a bound volume of the published papers as well.

For further information about this dual event write to the ASME Meetings Department, 29 West 39th Street, New York 18, N. Y.

Program Announced for...

...Third Annual Joint Conference on Automatic Techniques

What. For the third consecutive year, the American Institute of Electrical Engineers, The American Society of Mechanical Engineers, and the Institute of Radio Engineers have joined to cosponsor the Joint Automatic Techniques Conference.

When and Where. The 1960 conference will be held April 18 and 19 in Cleveland, Ohio, at the Sheraton-Cleveland Hotel.

Why. The increasing complexity in all specialized fields of endeavor makes it difficult to identify and understand the unifying theme of all modern technologies—automatic techniques. As it is envisioned, this unique conference draws upon the experiences of a variety of industries, obtaining both a general outline of certain problems that have confronted the industries and a discussion of the automatic techniques and the reasoning that was applied in solving the problems. Dealing broadly with techniques that have proved successful in solving practical problems, the conference appeal cuts across both industry classifications and job-function categories.

Who's Who. National Steering Committee: F. D. Snyder, Westinghouse Electric Corporation (AIEE); Mead Bradner, Foxboro Company (ASME); and J. E. Eiselein, RCA (IRE).

National Program Chairman: L. W. Herchenroeder, Westinghouse Electric Corporation (ASME).

Cleveland Conference Cochairmen: J. W. Picking, Reliance Electric and Engineering Company (AIEE); Roger W. Bolz, *Automation* (ASME).

▶ MONDAY, APRIL 18

Session 1—Automatic Manufacturing

Metal Forming Under Electronic Sequencing, by *E. V. Crane*, E. W. Bliss Co., Canton, Ohio. A discussion of computer-type controls for various metal-firming operations; electronic control of rolling mills; press-drive controls; and synchronization of press equipment.

Automatic Assembly, by *J. F. Stoltz*, Hawthorne Works, Western Elec. Co., Chicago, Ill. A review of factors which affect the feasibility of automatic manufacture and assembly, including the influence of product design and a discussion of economic criteria in determining feasibility.

Numerical Control Developments, by *R. G. Chamberlain*, Giddings & Lewis Machine Tool Co., Fond du Lac, Wis. Covers latest developments and applications of continuous-path and discrete-positioning controls as applied in a variety of industries.

Session 2—Automatic Inspection and Quality Assurance

Automatic Gaging, by *H. L. Boppel*, Sheffield Corp., Dayton, Ohio. Reviews automatic gaging as applied to typical multiple machine control, automatic inspection and assembly, and automatic inspection machines.

Production-Line Testing Programmed by Punched Cards, by *R. E. Wendt, Jr.*, Westinghouse Electric Corp., Pittsburgh, Pa. Report of unique testing system that is punched-card programmed to handle random mix of power capacitors, system includes a computer-type optimizing control setup.

Airframe Structural Integrity Testing, by *R.L. Bondurant* and *D. W. Jackson*, Wright Air Development Center, Wright-Patterson AFB Ohio. Discussion of data-handling system which monitors conditions during a test by collecting, recording, reducing, analyzing, storing, and reading out resultant data.

▶ TUESDAY, APRIL 19

Session 3—Computer Control for Utilization and Process Industries

Operational Information System at Sterlington Steam-Electric Station, by *J. A. Reine, Jr.*, Sterlington Steam Electric Station, Sterlington, La. Report of experience with Daystrom Systems solid-state digital computer used to log information and guide operator in control of power-generating plant.

Problems Encountered and Solved in Starting of Computer-Controlled Systems, by *W. F. Aiken*, Thompson-Ramo-Wooldridge Products Co., Los Angeles, Calif. Covers experience gained with RW-300 digital computer in such diverse applications or production testing as nuclear reactor monitoring, vinyl chloride monomer production unit, weather-data reduction, and oil-refinery monitoring.

User-Supplier Relationship in Automating a Steel-Rolling Mill, by *C. W. Burdick*, Lukens Steel Co., Coatesville, Pa.; *N. L. Weckstein*, Gen. Elec. Co., Roanoke, Va.; and *R. A. Hamilton*, Gen. Elec. Co., Philadelphia, Pa. Using recent reversing plate mill as example, discusses problems of communications during design and construction, of determining process characteristics, and of integrating various components, such as computers, conventional controls, and mechanical equipment.

Session 4—Automatic Warehousing

Automatic Baggage Handling, by *H. C. Warrington*, United Air Lines, Denver, Colo. An idealized system involves a continuously moving conveyer fitted with carriers to hold pieces of baggage; desired location to which baggage is to be directed is keyed into memory system for automatic ejection of baggage at the proper time.

Automation as Applied to Book Warehousing and Shipping, by *J. B. Bennett, Jr.*, The Macmillan Co., New York, N. Y. New distribution center serves as basis for examination of problems confronting large book publisher in search of efficient operations with particular emphasis on automatic devices employed.

Automatic Palletization Facilities at C and H Sugar Refining Corporation, by *D.C. Gulleben*, California and Hawaiian Sugar Refining Corp., Crockett, Calif. Experience of company is related in establishing extensive conveyer and palletization system that handles paper bales and bags, as well as cases of refined sugar.

ASME-AIEE Railroad Conference to Be in Pittsburgh, Pa.

The Railroad Conference of the Railroad Division of The American Society of Mechanical Engineers and the Land Transportation Committee of the American Institute of Electrical Engineers will be held at the Penn-Sheraton Hotel, Pittsburgh, Pa., April 20–21, 1960.

The technical program will include interesting presentations on such topics as wheel-rail adhesion, railroad electrification, ore-unloading facilities, locomotive maintenance and its relation to the economy of railroad operation, automation in the industry, and diesel lube-oil analysis.

▶ WEDNESDAY, APRIL 20

Session 1 **9:30 a.m.**

The Slippery Spot Concept of Adhesion,[1] by *J. C. Aydelott*, Gen. Elec. Co., Erie, Pa.

Study of Defects That Originate and Develop in the Treads of Railroad Wheels During Service,[1]

[1] Paper not available—see box on page 126.

by *J. M. Wandrisco* and *F. J. Dewes, Jr.*, U. S. Steel Research Center, Monroeville, Pa.

Understanding Wheel-Rail Adhesion,[1] by *G. M. Cabble, Jr.*, Westinghouse Air Brake Co., Wilmerding, Pa.

Session 2 **2:00 p.m.**

The World's Most Modern Ore-Unloading Facility,[1] by *R. C. Tench*, C.&O. Railroad, Richmond, Va.

French Technical Advances in the Field of Railroad Electrification,[1] by *F. Nouvion*, French National Railroads, Paris, France

Forces Between Wheel and Rail,[1] by *F. F. Olson*, Swedish State Railroads, Stockholm, Sweden

▶ THURSDAY, APRIL 21

Session 3 **9:30 a.m.**

Locomotive Repair Costs and Their Economic Meaning to the Railways of the United States,[1] by *H. F. Brown*, Gibbs & Hill, Inc., New York, N. Y.

Electric Locomotive Maintenance Cost Equation,[1] by *J. W. Horine*, PRR, Philadelphia, Pa.

Spectrographic Analysis of Diesel Lube Oils,[1] by *J. C. Smith*, Gen. Elec. Co., Erie, Pa.

Session 4 **2:00 p.m.**

Automation in Railroading,[1] by *V. E. McCoy*, Chicago, Milwaukee, St. Paul & Pacific RR, Chicago, Ill.

Automated Testing of Railway Freight Brake-Control Valves, by *P. W. Brath* and *E. T. Skanter*, Westinghouse Air Brake Co., Wilmerding, Pa.

Air-Cleaning Features for Traction Equipment,[1] by *P. G. Lessman*, Westinghouse Elec. Corp., East Pittsburgh, Pa.

[1] Paper not available—see box on this page.

Availability of Papers

Only numbered ASME papers in this program are available in separate copy form until Feb. 1, 1961. Copies can be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Prices are 40 cents to members of ASME, 80 cents to nonmembers. Payment may be made by check, U. S. postage stamps, free coupons, or coupons which may be purchased from the Society. The coupons in lots of ten, are $3 to members; $6 to nonmembers. Papers must be ordered by the paper numbers listed in this program, otherwise the order will be returned. The final listing of available technical papers will be found in the issue of Mechanical Engineering containing an account of the conference.

Third Annual Maintenance and Plant Engineering Conference in St. Louis, Mo., April 25-26

ASME President Walker L. Cisler will speak at the Third Annual Maintenance and Plant Engineering National Conference to be held at the Chase Hotel in St. Louis, Mo., on April 25–26, 1960. Mr. Cisler will address those attending the Banquet on Monday evening (April 25).

The Conference will have three technical sessions and a panel discussion Tuesday afternoon. A total of eight technical papers are expected to be presented, among them are such thought-provoking subjects as: "Are You Getting The Plant You Want—And Paid For?" by R. M. Maxin of Day & Zimmerman, Inc., Philadelphia, Pa. At the luncheon on Monday, G. V. Williamson, vice-president of Union Electric company, St. Louis, Mo. will be guest speaker.

The latest developments in maintenance of machinery and equipment are included in the well-planned subject matter to be presented. This conference is sponsored by the Maintenance and Plant Engineering Division of The American Society of Mechanical Engineers in co-operation with the St. Louis Section and The American Institute of Plant Engineers.

▶ MONDAY, APRIL 25

Session 1 **9:30 a.m.**

Maintenance Men Important Today—A Necessity Tomorrow,[1] by *J. Vonderheide*, Gen. Elec. Co., Louisville, Ky.

Are You Getting the Plant You Want—and Paid For? by *R. M. Maxin*, Day & Zimmermann, Inc., Philadelphia, Pa.

Planning and Scheduling Machinery and Equipment Maintenance,[1] by *K. N. Banthin*, The Visking Co., Div. of Union Carbide Corp., Chicago, Ill.

Session 2 **2:30 p.m.**

Developments in Maintenance Welding—Chemical Plants,[1] by *W. H. T. Svanoe*, E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.

Industrial Lighting,[1] by *V. Kempf, Plant Engineering*, Chicago, Ill.

▶ TUESDAY, APRIL 26

Session 3

Maintenance of Power Transmission and Conveying Equipment, by *G. D. Young*, Link Belt Co., Philadelphia, Pa.

Maintenance of Gas-Driven Trucks,[1] by *J. Squires*, Clark Equipment Co., Battle Creek, Mich.

Maintenance Considerations of Electric Powered Trucks,[1] by *H. C. Bennett*, Lewis-Shepard Co., Watertown, Mass.

Session 4 Maintenance Forum 2:30 p.m.

During the conference questions and discussion topics will be solicited, and together with questions raised from the floor, will be discussed by the panel. This forum has become a traditional and valuable part of the conference.

Panel Members:

J. C. Humphreys, Day & Zimmermann, Inc., Philadelphia, Pa.

J. A. Rorick, IBM Corp., New York, N. Y.

W. C. Wallin, Western Elec. Co., Winston-Salem, N. C.

G. V. Williamson, Union Elec. Co., St. Louis, Mo.

[1] Paper not available—see box on this page.

ASME Members Asked to Act in ECPD Guidance Program

Engineers need not be reminded of the importance of technology to our economy. It also is obvious to engineers that continuation of our technical progress requires a steady and increasing flow of engineering graduates into the profession. The first step in securing the necessary growth in our engineering population is to interest qualified high-school students in engineering as a career. Thousands of engineers are giving unstintingly of their time to this effort. The help of more engineers is needed to develop and expand guidance programs for high-school students even further.

Individuals and local groups of engineers, at times, have undertaken engineering guidance work unaware of the co-ordinative role played in this field by the Engineers' Council for Professional Development Guidance Committee. Unco-ordinated guidance effort in an area by several different groups usually results in a duplication in school contacts and uneven standards in the conduct of the work. The co-operation of school authorities cannot be maintained where a unified approach by the profession does not exist.

ECPD State Committees were organized some years ago to co-ordinate the efforts of engineering groups engaged in guidance activity, to interest additional individuals or groups in guidance in order to obtain nationwide coverage of public, private, and parochial schools, and to promote the adoption of standards for the conduct of the work. These State Committees are grouped into eight regions for administrative purposes. The chairman of the National Guidance Committee is F. J. Jeffers, Mem. ASME, Senior Engineer, Baltimore Gas and Electric Company, Lexington Building, Baltimore 3, Md.

ECPD State Committees. The State Committees work directly with the high schools, counseling students to study mathematics and science and urging those with the necessary aptitude to consider a career in engineering. Interest in engineering is aroused through a wide variety of projects and programs: Through talks and panel presentations before student groups and assemblies and before teachers, vocational counselors, and parents; through inspection trips and the showing of appropriate technical films; through promotion of high-school engineering clubs and science fairs; through individual counseling; and other related activities. The National Guidance Com-

mittee supports the work of the State Committees through two annual mailings to the country's 30,000 high schools, providing literature, and calling the attention of the superintendents, principals, and counselors to the guidance services available to them from the State Committees.

This nationwide effort requires the assistance of large numbers of engineers. To help ASME members to participate in this fine program we list the Regional chairmen:

Region 1—Prof. E. T. Donovan, Mechanical Engineering Department, University of New Hampshire, Durham, N. H.

Region 2—Prof. H. E. Roemmele, Placement Officer, The Cooper Union, Cooper Square, New York 3, N. Y.

Region 3—D. M. Seeley, U. S. Steel Corporation, 525 William Penn Place, Pittsburgh 30, Pa.

Region 4—J. Harold Lampe, Dean of Engineering, North Carolina State College, Raleigh, N. C.

Region 5—G. P. O'Connell, General Motors Corporation, 3044 West Grand Boulevard, Detroit 3, Mich.

Region 6—Dean A. B. Drought, Engineering Department, Marquette University, 1515 W. Wisconsin Avenue, Milwaukee 3, Wis.

Region 7—Robert Matteson, California Research Corporation, Box 1627, Richmond, Calif.

Region 8—J. G. McGuire, Assistant to Dean of Engineering, A&M College of Texas, College Station, Texas.

Outside Continental U. S.—Canada—Donald A. Young, Foundation of Canada Engineering Corporation, Ltd., 1900 Sherbrooke Street, West, Montreal, Que.

ASME Metals Engineering Conference to Be Presented in Conjunction With AWS Annual Meeting in Los Angeles

The Conference of the Metals Engineering Division of The American Society of Mechanical Engineers will present four sessions during the American Welding Society's 41st Annual Meeting and Exposition. The meeting will be held in Los Angeles, Calif., at the Hotel Biltmore, April 25–29, 1960. The Exposition, to be held concurrently with this meeting, will be housed at the Great Western Exhibit Center in Los Angeles and will be of three days' duration, Tuesday through Thursday, April 26–28.

The ASME program is to be presented in four sessions, and will include papers on the following: Inconel alloy and forgings for nuclear power installations, as well as welding and fabrication of Inconel pipe; fracture mechanics; and nonmetallic structure materials.

The AWS program will include timely papers on the following: Resistance welding, structures, arc-welding applications, aluminum alloys, aircraft, rocketing, weldments, surfacing, high alloys, oxygen cutting, gas-shielded welding, brazing, pipelines, and processes.

A varied program has been arranged to be presented in some 23 technical sessions comprising 69 papers. President's reception and annual banquet, plant tours, informal panel discussion, educational lecture series, many committee meetings, and a delightful program for the ladies round out the program. An outstanding event will be the presentation of the AWS Annual Adams Lecture by Robert D. Stout, Lehigh University, on the topic, "Higher Strength Steels in Welded Structures."

The tentative ASME schedule of technical papers is as follows:

▶ TUESDAY, APRIL 26

Session 4—Fracture Mechanics 9:30 a.m.

Crack Propagation in Thin Metal Sheet Under Repeated Loading,[1] by *H. W. Liu*, University of Illinois

Minimum Toughness Requirements for High-Strength Steel Sheet,[1] by *J. A. Kies*, U. S. Naval Research Laboratory; *H. L. Smith*, U. S. Naval Weapons Plant, Washington, D. C.; and *H. E. Romine*, U. S. Naval Weapons Laboratory, Dalgren, Va.

Energy Versus Stress Theories for Combined Stress—A Fatigue Experiment Using a Rotating Disk, by *W. N. Findley*, Brown Univ.; *P. N. Mathur*, Bendix System Div., Ann Arbor, Mich.; *A. O. Temel*, Robert College, Istanbul, Turkey; and *E. Sscsepanski*, Brown Univ. (Paper No. 60—Met-1)

Microplastic Strain Hysteresis Energy as a Criterion of Fatigue Fracture, by *C. E. Feltner* and *J. Morrow*, Univ. of Illinois. (Paper No. 60—Met-2)

Session 7—Fracture Mechanics 2:00 p.m.

Fracture of Flat and Curved Aluminum Sheets With Stiffeners Parallel to the Crack, by *J. Frisch*, Univ. of California (Paper No. 60—Met-3)

A Study of Theories of Fracture Under Combined Stresses, by *I. Cornet* and *R. C. Grassi*, Univ. of California (Paper No. 60—Met-4)

Brittle Fracture Characteristics of a Reactor Pressure-Vessel Steel,[1] by *E. T. Wessell* and *W. H. Pryle*, Westinghouse Research Lab., Pittsburgh, Pa.

Use of Center Notch Tensile Test to Evaluate Rocket Chamber Materials,[1] by *J. J. Warga*, Aerojet-General Corp., Sacramento, Calif.

▶ WEDNESDAY, APRIL 27

Session 10—Welding and Fabrication of Inconel 9:30 a.m.

Nickel-Chromium-Iron Alloy (Inconel) Forgings for Nuclear Reactor Systems—A Summary of Forging Techniques and Mechanical Properties, by *C. L. Dotson* and *R. L. Roshong*, Cameron Iron Works, Houston, Texas (Paper No. 60—Met-5)

Arc Welding of a Ni-Cr-Fe Alloy (Inconel) for Nuclear Power Plants, by *J. Bland* and *W. A. Owczarski*, Gen. Elec. Co., Schenectady, N. Y. (Paper No. 60—Met-6)

Fabrication of a One-In-Thick Ten-In. Diam Welded Nickel-Chromium-Iron (Inconel) Pipe, by *W. L. Fleischmann*, Gen. Elec. Co., Schenectady, N. Y.; and *F. R. Gurnsa*, Midwest Piping Co., Inc., St. Louis, Mo. (Paper No. 60—Met-7)

Session 13—Nonmetallic Structural Materials 2:00 p.m.

Glass-Ceramics-Principles, Practices, and Properties,[1] by *S. D. Stookey*, Corning Glass Works, Corning, N. Y.

Recent Advances in Dispersion Hardened Metal—Metal Oxide Structures,[1] by *N. J. Grant* and *K. M. Zwilsky*, M.I.T.

Effect of Residual Stress on the Fatigue Strength of Ceramic Coatings—Metal Compositor,[1] by *J. H. Launcher*, Univ. of Illinois

[1] Paper not available—see box on page 126.

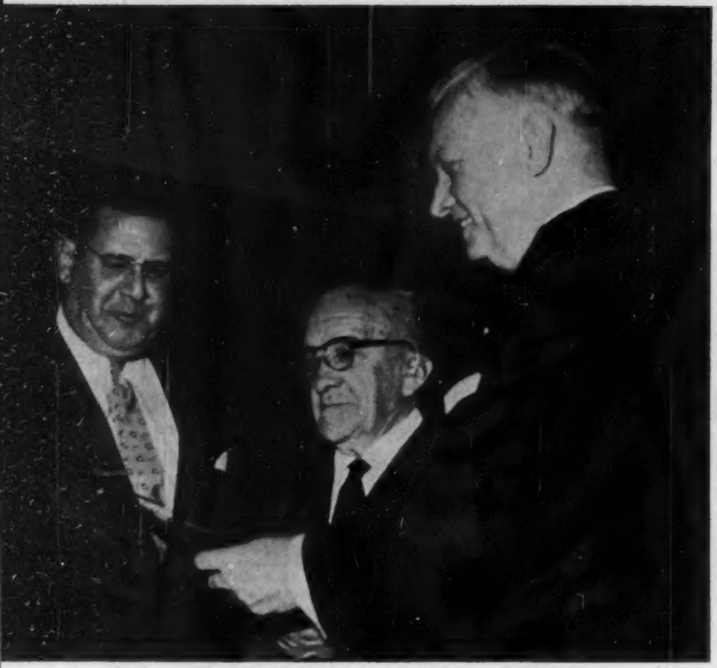
1960 ASME-ASCE West Coast Applied Mechanics Conference

Purpose of the Conference. The purpose of the Conference is to promote presentation and discussion of information and original research in the applied mechanics field, including the subjects of linear and nonlinear dynamics, vibration, elasticity, plasticity, viscoelasticity, and properties of materials, and also to provide an opportunity for acquaintance among those interested in these fields.

Sponsors. The West Coast Conference of Applied Mechanics is sponsored jointly by the Applied Mechanics Division of The American Society of Mechanical Engineers and the Engineering Mechanics Division of the American Society of Civil Engineers. The conference will be held at California Institute of Technology, June 27–29, 1960.

Papers. Papers will be accepted for presentation at the Conference until the program is filled. Manuscripts which are not processed through the regular channels of ASME or ASCE, but which are submitted directly to the Conference, should be sent to one of the following: Prof. W. Goldsmith, Division of Mechanics and Design, University of California, Berkeley 4, Calif.; Prof. G. A. Zizicas, Department of Engineering, University of California, Los Angeles 24, Calif.; and Prof. J. M. Gere, Department of Civil Engineering, Stanford University, Stanford, Calif.

Professor Gere will accept papers intended for sponsorship by ASCE. Papers intended for ASME sponsorship should be submitted to either Professor Goldsmith or Professor Zizicas; such papers will be submitted to West Coast reviewing and, if accepted, will be published in the *Journal of Applied Mechanics*.



F. H. Colvin, center, is presented with a certificate and congratulated on 65-year membership in ASME, by W. L. Cisler, right, ASME President, and O. B. Schier, II, secretary, ASME. A luncheon was held in his honor at the Engineers' Club, New York City, February 5.

ASME Honors F. H. Colvin, 65-Year Member

FRED HERBERT COLVIN is 93, and he has been a member of ASME for 65 years. These are facts which would set Mr. Colvin apart if he hadn't otherwise distinguished himself as a machinist, mechanical engineer, writer, and editor. At a luncheon on Feb. 5, 1960, at the Engineers' Club in New York, N. Y., ASME presented him with a certificate in recognition of his lifetime of distinguished service to mechanical engineering, and his membership in the Society. He has been a Fellow of ASME since 1941, a year in which some of our student members were born.

Actually, the 65-year certificate was previous by about three months, but had we waited for the precise anniversary the lively Mr. Colvin would have been out of reach. In April, he is going to England by Comet jet. While abroad, he will do what he always has done in 60 years of extensive travel that took him to every corner of the U. S. and to places as far away as China—he will visit machine shops, talk to machinists and engineers, and generally revel in the machinists' art which has been his life.

Mr. Colvin is editor-emeritus of *American Machinist*. He was the first editor of *Machinery*, and associate editor and business manager of *Railway & Locomotive Engineer*. He has written about 20 volumes, one of them the famous "American Machinist's Handbook."

His career started in Philadelphia, Pa., in 1883, when he became an apprentice in the machine shop of the Rue Manufacturing Company. Those were the days when you worked by the light of a single gas flame, and if you didn't get a sliver of steel in your eye you hanged yourself by the belt drive of your machine. The blizzard of '88 shattered Mr. Colvin's five-year punctuality record with the company.

Years later— after he had been a draftsman at Wheelock Engine Company and had been editor of *Machinery* (1894–1897)—Mr. Colvin was the first writer to be given access to the Ford plant. His main interest had been the machine tools that made the automobile industry possible, and with Mr. Ford's approval he wrote 16 articles on the Ford operation of Model-T days. Mr. Colvin had seen his first auto plant in 1899, when Ransom E. Olds showed him through the plant that built the curved-dash Oldsmobile.

This is the man who, in World War II—at 75—was a consultant to the Navy on steel propellers and simplified aircraft-landing gear, a man who will soon fly the Atlantic by jet.

Mr. Colvin, who lives at Point Pleasant Beach, N. J., still drives a car, but will have a driver in England because, "I don't feel like driving on the left side of the road." He will visit Scotland and Wales, visiting friends, and will also fly to Paris and Amsterdam. And after that? "Out" again, touring America, keeping in touch with the latest developments in machine tools, the "machines that can reproduce themselves," that make all other machinery possible.

"Nowadays," he says, "I visit machine tool firms, and the heads of the companies are the grandsons of the men I first knew there."

S. I. Juhasz Named Editor of "Applied Mechanics Reviews"

THE appointment of Stephen I. Juhasz, Mem. ASME, of Southwest Research Institute as editor of *Applied Mechanics Reviews* has been announced by O. B. Schier, II, secretary, ASME. Previously, Dr. Juhasz was executive editor of the publication.

Martin Goland, Mem. ASME, president of Southwest Research Institute and editor of the magazine for ten years, becomes the editorial adviser. Hugh L. Dryden, Fellow ASME; Theodore von Karman, Mem. ASME; and Stephen P. Timoshenko, Hon. Mem. ASME, all serve as Honorary Editors.

Dr. Juhasz has been executive editor of *Applied Mechanics Reviews* since 1953. Before that time he was affiliated with the Massachusetts Institute of Technology, the University of Toronto, and the Royal Institute of Technology in Stockholm, Sweden. He is the author of a number of technical publications.

Applied Mechanics Reviews is published monthly by The American Society of Mechanical Engineers and edited by Southwest Research Institute in San Antonio, Texas. In it are published critical reviews in the field of applied mechanics (of primary publications and books) which originate in more than 40 countries. The number of items, including authors' summaries and title listings, is over 7000 a year. More than 1500 engineers and scientists in 30 countries serve as voluntary reviewers. Articles originally published in 20 languages are handled in the magazine.

Applied Mechanics Reviews may be ordered through the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Subscription rates are as follows: $25 to nonmembers of ASME; $2.50 a single copy; and $10 to ASME members.

Dean Mavis Explores Problem Areas in Engineering Education

"Certainly engineering and science are as essential one to the other in advancing our civilization and general well being as a hen and rooster are one to the other in maintaining the flocks that keep us supplied with fresh eggs. The engineering hens round out the eggs, hatch them, and start broods scratching and foraging for themselves. The scientific roosters contribute some fertile ideas in the cycle and do most of the crowing," said F. T. Mavis, Mem. ASME, dean, College of Engineering, University of Maryland.

That provocative paragraph was an introduction to the problem of defining what is an engineer and how can you distinguish him from a physical scientist in a talk by Dean Mavis on "Problem-Areas in Engineering Education" presented at an ASME Washington, D. C., Section Meeting, Jan 14, 1960.

Dean Mavis stated that the differences between a scientist and engineer are subtile and defy *our* five basic senses of touch, taste, sight, smell, and hearing. Although the training, appearance, and manner of engineers and scientists may be quite similar, *their* tastes and *their* sniffing abilities differ. "The taste of the scientist and his nose for following some new scent into the unknown is likely to be that of a ferret in an unexplored thicket. He may be lost in the brush for a long while; but when he emerges at some unexpected spot there is likely to be much enthusiasm and some headlines marking a scientific break-through which may someday be useful to mankind.

"The engineer has some of the talents of a well-trained bird dog. As such, he goes hunting—not by himself, but with a party of men. He may follow the same scent as the scientific ferret. However, as a well-trained dog he points to his quarry, flushes it into the open, and (if the team-effort is successful) he retrieves the quarry for his master. For this success he gets a pat on the head, a biscuit, and a new area to hunt. This engineering bird-dog's accomplishments make headlines also, but mostly in the advertising sections of papers and magazines pointing up new plants, new production, new devices . . ." His quarry has been "bagged in the open field of free enterprise where there is always good hunting."

"The engineer must follow the same paths and scents as a scientist. Accordingly, the professional engineer must know what is useful or what may soon be useful in the same basic sciences as does the scientist—but he must know more and be able to do more. An engineer must—by design that is often ingenious—devise ways to apply scientific know-how adequately, usefully, economically, and at a proper time." Further, Dean Mavis said, "Sometimes the engineer must be ahead of science in that he is called upon to make things useful which are not yet fully understood mathematically or scientifically."

Two Approaches to Preparedness. To answer the complaint that so few high-school graduates are prepared to enter college as engineering freshmen, he suggests two approaches. First, a change in attitude on the part of the students and their parents who must realize, he states, that learning requires effort and that there is a big difference between actively learning and passively being taught. Second, high-school graduates who are not adequately prepared for engineering should be required to pursue an intensive summer program "of work aimed to close the gaps in their preparation, and to give them an introduction to the pace of freshman mathematics and English in a college of engineering."

College Curriculum Restudied. He suggests that the college curriculum should also be restudied and replanned so that the student would have only four or five academic subjects in one semester. The four-year program leading to the bachelor's degree would be subdivided into four approximately equal parts: (*a*) "Basic physical sciences of mathematics, physics, chemistry" taught in some depth and not as mere surveys of the subject area; (*b*) "the engineering sciences—mechanics, materials, thermodynamics, elements of electrical engineering, fluid mechanics" to be the same for students in all major curriculums; (*c*) "major-line courses selected from and appropriate to the field of major study, providing emphasis on analysis, synthesis, teamwork, and dealing with problems as a whole with the opportunity for the better students to work in small teams of departmentally approved and guided projects; (*d*) a common humanistic-social stem including English, history, economics, and the "graphic language" as a minimum. Dean Mavis' paper included specific recommendations on the method of teaching certain subjects.

He concluded with a recommendation that "professional-society seminars" be added in the junior and senior years where students would be responsible for putting on programs, presenting papers, discussing papers current in professional journals, "and generally accepting responsibility for group activity as young professional men in-the-making."

Section by Section . . .

. . . They build a better profession through a stronger ASME

Professional Registration Aided by Nebraska Section

The ASME Nebraska Section has undertaken the sponsorship of an annual engineering refresher course for mechanical engineers who plan to take the Nebraska State Board examination for professional registration. The program was initiated in September, 1959, by the executive committee to promote professionalism among mechanical engineers and to interest nonmembers in joining the ASME.

A refresher-course committee was appointed composed of the following personnel: Ed Drdla, John Peterson, Leonard Lowder, Prof. John Kurtz, and Prof. Keith Newhouse. Two separate courses were offered: One in Omaha, taught by Mr. Drdla, and the other in Lincoln, taught by Professor Newhouse.

After suitable classroom facilities were obtained, arrangements were made to conduct four two-hour sessions on four consecutive Friday nights, beginning Sept. 18, 1959. Notice of the course was made in local newspapers, in company bulletins and publications, in meeting announcements, and by word of mouth. Classes were open to both members and nonmembers.

The course was attended in Omaha by 29 men, seven of whom are ASME members, and in Lincoln by eight ASME

View of an Omaha classroom. Students preparing for Nebraska State Board examination for professional registration.

members. Instruction was of the class-participation type. Problems were assigned to individuals who presented solutions to the class at subsequent meetings. Discussion followed each solution.

Results of the first refresher course are gratifying. Of the 37 men who attended, 32 took the examination and 30 passed.

Petroleum Activities Committee Formed in Tulsa

Ten members of the ASME Mid-Continent Section have formed a Petroleum Activities Committee. The object is to hold a series of luncheon meetings with a speaker or speakers who are specialists in some phase of the oil and gas industry to provide better exchange of engineering information related to the petroleum industry. Approximately 150 came to the kickoff luncheon on October 13, and 250 turned out for the second, December 1, to hear what the experts had to say about how to drill and produce a 50,000-ft oil well.

It can be done, but an oil operator probably would have more trouble producing a 50,000-ft well than drilling it. However, he is not likely to drill one that deep in the immediate future. He probably can overcome mechanical problems, but the cost would be too high and the pay-off too poor to justify it.

On January 19, at the third in the Petroleum Activities Committee series of luncheon forums, discussion was devoted to recent changes in the ASME-ASA Piping and Pressure Vessel Codes. These codes form the basis for many state and city safety codes for piping and pressure vessels and thus provide safety for the public at large as well as persons directly associated with piping and pressure vessels. They also serve as a standard of reference for minimum safety requirements by equipment manufacturers, architects, engineers, erectors, and others concerned with pressure piping. The codes have been developed over a period of many years and meetings of this kind have contributed much to their development. Users were urged to join in the discussion to present personally their needs for consideration.

Pittsburgh Management Division Holds Cost Control Meeting

"Cost Control in Engineering Design," was the topic of a recent meeting of the Engineering Management Division of the ASME Pittsburgh Section. Speaker Louis M. Kuh, engineering management consultant, H. B. Maynard and Company, Inc., divided the costs associated with engineering design into two categories. These are: engineering costs, the expense of maintaining an engineering department; and costs of engineering, the costs resulting from the design.

Controlling engineering costs is primarily the task of controlling time. The sooner a product is on the market, the more profit there is on investment. Engineering effort can be controlled by breaking the job or project into elements and arranging a work schedule. The schedule permits better co-ordination between those involved in the project, encourages getting done on time, and signals potential delays and bottlenecks.

The costs of engineering hinge upon the quality of engineering. Quality is improved with a consequent decrease in costs if the engineering staff knows the capabilities and problems of others. The design for a product should be appropriate for manufacturing on the company's equipment, utilizing components and materials standard to the company. Foresighted design providing ease of maintenance may affect substantial future savings.

Mr. Kuh concluded that the key to cost control in engineering design is to develop cost-conscious engineers.

Why Do Machine Parts Break Down? Basic ASME Research Study Aims to Find Out

A SPOKESMAN for The American Society of Mechanical Engineers called upon American industry to support a basic research study aimed at discovering why machine parts break down. "In an era when the failure of a single critical part, in a space rocket, for example, can lead to the failure of a multimillion-dollar project, we can no longer afford to rely upon rules of thumb," he said.

In announcing the project, to be conducted under the auspices of ASME, Paul Lewis, Assoc. Mem. ASME, spokesman for the ASME Research Committee on Contact Fatigue on Rolling Elements, said, "It is essential that we gain a better understanding of why machine elements fail. Only by defining the failure mechanism can we expect to make significant improvements in the life of such elements."

"Our technological rivals in other nations can dictate the devotion of large sums of money and many man-hours of time to such efforts. In this country, however, we must rely on co-operative efforts to accomplish our aims. In the near future, industrial organizations who share this problem will be contacted for help in the execution of this research project."

Research projects conducted by The American Society of Mechanical Engineers are limited to those of nonproprietary interest. The objectives of such programs are to fill gaps in basic engineering knowledge which will aid in the advancement of the art and science of engineering.

Mr. Lewis continued, "The history of machine elements, particularly those which are subjected to contact stresses, has been marked by substantial improvements in accuracy, materials quality control, and design improvements. But because of the lack of understanding of the basic failure mechanism, a major breakthrough has not been made in defining the failure process to permit accurate prediction of the operating life of a given item. Machine elements in this category include rolling element bearings, gears, and cams."

Nominations Wanted Now!

National Nominating Committee Stresses Democratic Procedure for Finding National Officers for ASME

DURING the 1960 Summer Annual Meeting, the National Nominating Committee will meet to choose nominees for President, Vice-President of Regions II, IV, VI, and VIII, and for two Directors of the Society. You are reminded that the Nominating Committee can perform its function only if the Society members provide that body with the names of outstanding individuals for consideration.

These men, as officers of a $2-million corporation, should be leaders in their profession and in their community.

Each member of the Society no doubt is aware of one or more such leaders in his community, Section, or Region—men who over the years have served the Society well and have helped to make ASME the world-famed organization it is. It is your duty and privilege as a member to suggest such men for consideration as officers of the Society. Each ASME

Section has an adviser on nominations who will see that your suggestions are forwarded to your Regional Nominating Committee Member. The latter or your Section Adviser will assist in the preparation of the nomination sponsorship form. If you do not have already the official Nominating Form you may secure such from John W. McKiernan, Secretary of the National Nominating Committee, Sandia Corporation, Sandia Base, Albuquerque, N. Mex.

The National Nominating Committee will meet on June 6 and 7 during the 1960 Summer Annual Meeting at the Statler Hilton Hotel, Dallas, Texas, to consider the prospective nominees. At this time, any member may appear before the Committee to advocate further the nomination of a candidate.

Ours is a democratic society.[1] The caliber of national officers who will direct the affairs of our Society during the next one to four years is squarely up to you. Why not do something about it? RECOMMEND A CANDIDATE.

[1] See Article B7, Paragraph 20 of our Constitution, ASME Manual MM-1.

1960 ASME Regional Student Conferences

Region	Host	Place	Date
I	University of Vermont	Burlington, Vt.	April 22–23
II	Newark College of Engineering	Newark, N. J.	April 23
III	Drexel Institute of Technology	Philadelphia, Pa.	April 22–23
IV	University of South Carolina	Columbia, S. C.	April 22–23
V	The Ohio State University	Columbus, Ohio	April 1–2
VI	Illinois Institute of Technology Northern Tier	Chicago, Ill.	May 6–7
VI	State University of Iowa Southern Tier	Iowa City, Iowa	April 1–2
VII	University of Idaho Washington State University Pacific North West	Moscow, Idaho	April 29–30
VII	Stanford University Pacific South West	Stanford, Calif.	May 6–7
VIII	University of Nebraska Northern Tier	Lincoln, Neb.	May 2–3
VIII	Tulane University Southern Tier	New Orleans, La.	April 1–2
VIII	Colorado State University Rocky Mountain Tier	Fort Collins, Colo.	April 22–23

ASME COMING EVENTS

March 6–9

ASME Gas Turbine Power and Hydraulic Conference, Rice Hotel, Houston, Texas

March 14–15

ASME Lubrication Symposium, Engineering Societies Building, New York, N. Y.

March 29–31

American Power Conference, Hotel Sherman, Chicago, Ill.

March 31–April 1

ASME Textile Engineering Conference, North Carolina State College, Raleigh, N. C.

April 4–8

Nuclear Congress and Exhibit, Coliseum, New York, N. Y.

April 7–8

ASME-SAM Management Conference, Statler Hilton Hotel, New York, N. Y.

April 20–21

ASME-AIEE Railroad Conference, Penn-Sheraton Hotel, Pittsburgh, Pa.

April 24–29

ASME Boiler and Pressure Vessel Committee Out-of-Town Meeting (joint with the National Board of Boiler and Pressure Vessel Inspectors), Brown Palace Hotel, Denver, Colo.

April 25–26

ASME Maintenance and Plant Engineering Conference, Chase-Park Plaza Hotels, St. Louis, Mo.

April 25–29

ASME Metals Engineering Division-AWS Conference, Hotel Biltmore, Los Angeles, Calif.

May 17–19

ASME Production Engineering Conference, Hotel Schroeder, Milwaukee, Wis.

May 22–26

ASME Oil and Gas Power Conference and Exhibit, Muehlebach Hotel, Kansas City, Mo.

May 23–26

ASME Design Engineering Conference and Show, Statler Hilton Hotel, New York, N. Y.

June 5–10

ASME Summer Annual Meeting and Aviation Conference, Statler Hilton Hotel, Dallas, Texas

June 20–22

ASME Applied Mechanics Conference, The Pennsylvania State University, University Park, Pa.

June 27–29

ASME West Coast Applied Mechanics Conference, The California Institute of Technology, Pasadena, Calif.

August 15–17

ASME-AIChE Heat Transfer Conference and Exhibit, Statler Hilton Hotel, Buffalo, N. Y.

September 7–9

ASME Joint Automatic Control Conference, Massachusetts Institute of Technology, Cambridge, Mass.

September 15–16

ASME-AIEE Engineering Management Conference, Morrison Hotel, Chicago, Ill.

September 21–23

ASME-AIEE Power Conference, Bellevue-Stratford Hotel, Philadelphia, Pa.

September 26–28

ASME Petroleum Mechanical Engineering Conference, Jung Hotel, New Orleans, La.

October 9–12

ASME Rubber and Plastics Conference, Lawrence Hotel, Erie, Pa.

October 17–19

ASME-ASLE Lubrication Conference, Statler Hilton Hotel, Boston, Mass.

October 24–25

ASME-AIME Fuels Conference, Daniel Boone Hotel, Charleston, W. Va.

November 27–December 2

ASME Winter Annual Meeting, Statler Hilton Hotel, New York, N. Y.

(*For Meetings of Other Societies see page 121*)

Note: Persons wishing to prepare a paper for presentation at ASME National meetings or division conferences should secure a copy of Manual MS-4, "An ASME Paper," by writing to the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Price to nonmembers 50 cents; to ASME Members, free.

Conducted for the National Junior Committee

J.R. BERENDES[1]

JUNIOR FORUM

Regional Prize Paper Contests

The Society's prime objective is to advance mechanical engineering and its allied arts and sciences. A prize paper contest is an excellent medium to achieve that goal.

The prize paper contest under consideration is for the use of the young engineers. This type of participation essentially is to instill in him the desire to be an active member, one who is not only accepted but desired by the society. The preparation and presentation of a paper by a qualified member would enable him to: (*a*) Make a contribution to the society; (*b*) gain experience in writing; (*c*) speak before a professional group; (*d*) get his own company's recognition; and (*e*) gain satisfaction both from personal prestige and the value of the prize.

Depending upon the desires of any given area, the scope of the contest could be technical or not; it could be limited to one subject or unrestricted. There are many questions to be answered and many decisions to be made, but if the objectives are to be reached a start must be made.

Region VI recently made its move to make such a contest a reality. The successful prize paper contests held by the Chicago Section largely influenced this decision. The rules of the Chicago Section were changed and/or modified to reflect the needs of the region.

Prize Paper Contest Rules

1 The purpose of this contest is to provide an opportunity for the Associate Members of Region VI to participate in the Regional activities and to be recognized for their efforts.

2 This contest is only open to Regional Junior Members in good standing who are 30 years of age or younger.

3 Papers submitted after final closing date of April 1 will be rejected and may be submitted in the next contest.

4 Papers should be of a technical nature concerning the contestant's work or interests. Papers of a political, editorial, or advertising nature will not be accepted.

5 Papers should be written in a form similar to that proposed by ASME Manual MS-4 entitled "An ASME Paper"; copies of which are available from ASME headquarters, 29 West 39th Street, New York 18, N. Y.

6 Contestant should obtain clearance for paper from his company, if necessary, as all worthy papers will be forwarded to ASME Publications Committee for possible publication.

7 Papers should be between 2000 and 4000 words. These limits are set as a guide and are not to be considered as final. If orally presented, however, it must be limited to 15 min with a five-min question period following the presentation period.

8 Papers will be judged by a committee appointed by the Regional Vice-President on the following basis: (*a*) Author's knowledge of subject; (*b*) reader's interest; (*c*) composition; (*d*) contents; and (*e*) illustrations.

Prizes to Top Three Papers

Chicago prizes will be awarded to the three top papers as based on the results of the evaluation. The scores will be evaluated to determine the top three papers. Judging is on the following basis:

Contents (unity, coherence, and adequate development).......	30
Composition..................	30
Reader interest................	20
Illustrations..................	10
Author's knowledge of subject..	10
Possible total..................	100

The success of this venture depends largely on personal appeals to the younger members of the region, but in the final analysis only the support of the entire region will insure this sought after goal.

[1] Sales Representative, Combustion Engineering, Inc., Chicago, Ill. Assoc. Mem. ASME.

1959 NJC Annual Meeting Reporter

Due to the author's modesty, the write up of National Junior Committee activities at the 1959 ASME Annual Meeting, as reported in "Junior Forum" in January, was unsigned.

NJC, holding no brief for anonymity, takes this opportunity to inform the readers of "Junior Forum," that the author was R. J. Williams, Assoc. Mem. ASME, power apparatus sales engineer, Westinghouse Electric Corporation, Chicago, Ill.

Chairman's Corner

The Elixir of Enthusiasm

In these days of tranquilizers and sleeping pills the value of the old-fashioned brand, enthusiasm, is often overlooked. This tonic is difficult to define. Yet it is easily recognized by the firm handshake and smile of a Society Member who is sincerely pleased to see you at a section meeting; a man aware of your mutual interests.

Enthusiasm is infectious. One man animates another, makes him an ally, and thus builds co-operation and teamwork. Enthusiasm initiated by one has the habit of being returned at times when most needed. And it is self-infectious. Enthusiastic interest in one subject leads to a "discovery" of other fields, sometimes more absorbing than the first. It builds up momentum, leveling out obstacles. It makes for a deeper understanding; details appear in sharper focus, permitting saturation of the subject, and thereby advancing personal technical competence.

Self-confidence can be a by-product of enthusiasm. This leads to the ability to absorb greater responsibility.

Enthusiasm doesn't appear without the application of effort. It is difficult to induce it alone. If you feel you can use more yourself, get involved in young Associate Members activities in ASME. If you have lots of enthusiasm, bring it—there'll be lots of company. We can all gain from injections of this inexpensive and readily available elixir. Try it and be prepared for the best.—*Adapted from an IRE Chapter Newsletter.*

ASME CODES AND STANDARDS WORKSHOP

Interpretations of 1955 Code for Pressure Piping

From time to time certain actions of the Sectional Committee B31 will be published for the information of interested parties. While these do not constitute formal revision of the Code, they may be utilized in specifications, or otherwise, as representing the considered opinions of the Committee.

Pending revision of the Code for Pressure Piping, ASA B31.1-1955, the Sectional Committee has recommended that ASME, as sponsor, publish selected interpretations so that industry may take immediate advantage of corresponding proposed revisions. Case No. 45 is published herewith as an interim action of Sectional Committee B31 on the Code for Pressure Piping that will not constitute a part of the Code until formal action has been taken by the ASME and by the American Standards Association on a revision of the Code.

Case No. 45

Inquiry: Paragraph 845.42(a) states that liquid seal relief valves must close when the pressure in the distribution system returns to normal. Does this preclude the use of manual resetting relief valves under the rules of Section 8 of the Code for Pressure Piping (ASA B31.8-1958)?

Reply: It is the opinion of the Committee that Par. 845.42(a), Section 8 of ASA B31.8-1958 should be changed as follows:

845.42(a)—A liquid seal relief device that can be set to open accurately and consistently at the desired pressure.

New Milling Cutter Standard

By E. A. Goddard, Chairman, B5 TC5

The original reasoning behind the development of this milling cutter standard was to provide the metalworking industry with a well balanced assortment of milling cutter types, and sizes within each, sufficient to cover most of its needs on an off-the-shelf basis. The economic advantages to the user as well as the manufacturer are obvious and are a fundamental plank in the platform of standardization.

This present review was predicated on the need to bring a 1950 standard up-to-date, and the potential opportunity presented therewith to improve it by broadening where practicable. As the result of that review, the scope of this standard was widened to include nomenclature of the elements of the cutters involved and to deal more broadly with tolerances.

Nomenclature, previously contained in a separate ASA standards publication, now is included in this work in so far as it deals with the various features of milling cutters and milling cutter teeth.

Tolerances applicable to dimensions have been segregated to better present them and tolerances applying to operational features of milling cutters, such as radial and axial runout, having been developed for the first time are included in this publication.

At the same time this review narrowed the scope of this standard to the degree that it has restricted its contents to only those milling cutters considered eligible for inclusion in a national standard. For example, this involves showing only one-piece solid cutters usually made of high speed steel; thus excluding cutters of the inserted blade type which now are covered for the first time in a standards work recently accepted by the American Standard Association and designated as ASA B5.23-1958.

Another restriction excludes from this standard any showing or mention of milling cutters made of or designed to carry tips of hard alloys, such as the cemented carbides. Although many cutters of this type now are available, it is believed they are not appropriate to this particular standard, at least not at this early date.

Revised American Standard for Spindle Noses

By C. T. Blake, Chairman, B5 TC/4

This revision supersedes ASA B5.9-1954. Tolerances for length of pilot and depth of pilot holes for the Type A-1 and B-1 spindles have been decreased slightly to reflect current actual practice in order to reduce the possibility of distorting the chuck or face plate when mounted on the spindle. For the same reason, pilot bore diameters for some sizes of these chucks, and corresponding gage dimensions, have been changed to reduce interference between chuck and spindle pilot diameters. In addition, the method of dimensioning radial hole locations has been changed to follow the practice set forth in American Drafting Standards Manual on Dimensioning and Notes (ASA Y14.5-1957) to insure interchangeability.

Copies of Standards are available from the ASME Order Dept., 29 West 39th St., New York 18, N. Y.

ACTIONS ASME EXECUTIVE COMMITTEE

A meeting of the Executive Committee of the Council was held in the rooms of the Society on Friday, Jan. 8, 1960. There were present: W. L. Cisler, President; T. H. Dolan, H. N. Muller, W. H. Larkin, and R. B. Smith of the Executive Committee; A. M. Perrin and V. W. Smith, directors; E. J. Kates, treasurer; F. L. Schwartz, chairman, Organization Committee; W. F. Thompson, ASME Representative on UET; O. B. Schier, II, secretary; C. E. Davies, secretary-emeritus, ASME, and executive director of the United Engineering Center Project; T. A. Marshall, Jr., senior assistant secretary; W. E. Letroadec and W. E. Reaser, assistant secretaries; J. J. Jaklitsch, Jr., editor; H. I. Nagorsky, controller; and D. B. MacDougall, associate head, Field Service.

Affiliations. The Council approved the affiliations of the following local engineering groups with ASME Sections: Fairfield County with the Engineering Societies Council of Fairfield County, Conn.; Philadelphia with the Engineering and Technical Societies Council of Philadelphia; Providence with the Providence Engineering Society; Rochester with the Rochester Engineering Society, Inc.; Utah with the Utah Engineering Council; and Western Washington with the Puget Sound Engineering Council.

Student Sections. The council approved the establishment of the University of Mississippi Section of ASME at University, Miss. Also, the Council waived the initiation fee for those 1959 ME graduates of the University of Mississippi who submit prior to June 30, 1960, regular applications for Associate Membership in the Society.

United Engineering Center. President Cisler reported that he had contacted several members to enlist their aid in making personal appeals for contributions to the Member Gifts Campaign. He also advised that several substantial gifts had been made in the name of the Society within the past few weeks, enabling ASME to reach the 80 per cent mark in its quota. The President stated that there are encouraging signs that the work which had been done in the past is now beginning to be productive.

W. F. Thompson, Chairman of the UET Real Estate Board, reported to the Executive Committee of the Council on the progress made thus far on the building, and urged that ASME intensify its efforts to achieve and exceed its Member Gifts quota at the earliest possible date.

Certificates of Award. The Council authorized a special certificate for eighty years of membership in the Society for Henry Marx, Cincinnati, Ohio; a special certificate for sixty-five years of membership for Fred Herbert Colvin, Point Pleasant Beach, N. J.

Certificates of Award were granted to the following committee chairmen: William M. Morley, National Junior Committee; John de S. Coutinho, Publications Committee; and John F. Hitchcock, Research Executive Committee.

The Council granted a certificate for outstanding service in the development of codes and standards formulated under ASME sponsorship to George L. McCain.

A certificate of award was granted to the following Regional Committee chairman: Henry A. Naylor, Jr., Student Section Committee, Region III.

Certificates of award have been prepared for the following chairmen of Section Member Gifts Committees who have attained more than 100 per cent of their quota: R. B. Dowdell, Providence; and Edward Miller, Northern New Jersey.

Also, certificates of award have been prepared for Frank L. Bradley and Albert C. Pasini, retiring members of the Council Committee on Staff Personnel.

A certificate of award has been prepared for William F. Ryan who served as chairman of the national ASME Member Gifts Committee from 1957 to 1959.

Appointments. The Council approved the assignment of V. W. Smith as a director on the Board on Public Affairs, and the assignment of A. M. Perrin for a one-year term on the Organization Committee as a director in place of V. W. Smith.

Upon recommendation of the Publications Committee and approval of the President, the Executive Committee of the Council approved the appointment of Stephen I. Juhasz as editor of *Applied Mechanics Reviews*, in place of Martin Goland who will continue to serve AMR as editorial adviser.

Died. The Council noted with deepest sorrow the death on Dec. 29, 1959, of H. Birchard Taylor, Fellow and Vice-President of the Society, 1923–1925.

ASME Boiler and Pressure Vessel Committee to Hold 1960 Out-of-Town Meeting in Denver

The Boiler and Pressure Vessel Committee of The American Society of Mechanical Engineers holds six meetings a year; one of which is held outside of New York City. The 1960 meeting will be held jointly with The National Board of Boiler and Pressure Vessel Inspectors at the Brown Palace Hotel, Denver, Colo., from April 24 to April 29, 1960, inclusive.

Meetings will be held of the various subcommittees covering in part, power, fire-tube, and heating boilers as well as unfired pressure vessels. The National Board of Boiler and Pressure Vessel Inspectors also will hold sessions at this meeting. There will be addresses by the various state and city representatives. A banquet is scheduled for Wednesday evening.

The all-day session of the Boiler and Pressure Vessel Committee is planned for Friday. Meetings of the various subcommittees as well as the Boiler and Pressure Vessel Committee are open to the public.

Representatives from the Boiler and Pressure Vessel Committee and The National Board of Boiler and Pressure Vessel Inspectors as well as ASME Region VIII comprise the Planning Committee.

ENGINEERING SOCIETIES PERSONNEL SERVICE, INC [Agency]

These items are listings of the Engineering Societies Personnel Service, Inc. This Service, which co-operates with the national societies of Civil, Electrical, Mechanical, and Mining, Metallurgical and Petroleum Engineers, is available to all engineers, members or nonmembers, and is run on a nonprofit basis.

If you are interested in any of these listings, and are not registered, you may apply by letter or résumé and mail to the office nearest your place of residence, with the understanding that should you secure a position as a result of these listings you will pay the regular employment fee of 5 per cent of the first year's salary if a nonmember, or 4 per cent if a member. Also, that you will agree to sign our placement-fee agreement which will be mailed to you immediately, by our office, after receiving your application. In sending applications be sure to list the key and job number.

When making application for a position include eight cents in stamps for forwarding application to the employer and for returning when possible.

NEW YORK	CHICAGO	SAN FRANCISCO
8 West 40 St.	29 East Madison St.	57 Post St.

Men Available[1]

New York Office

Project Engineer, Design Engineer, or Plant Engineer, BSME; 41; chemical-plant design and construction, coded vessels, process and utility piping, refrigeration systems, project preparation, estimates, specifications, equipment foundations and supports, construction supervision, drafting supervision. $9600. Prefers East, West, or Midwest. Me-784.

[1] All men listed hold some form of ASME membership.

Engineering Manager, DESc; over 15 years' experience establishing successful new enterprises and improving existing equipment and processes, in plastics, foods, detergents, and petrochemicals. Creative developer, cost-minded, developing savings of over $300,000 a year and adding new products. $16,000–$18,500. Prefers Northeast, Midwest, and New York Metropolitan area. Me-785.

Plant Engineer, PE, BSME, MSME; 36; seven years' civil-mechanical experience in design, modernization, and maintenance of oil refinery, waterfront facilities, cranes, heavy steel fabrication, materials handling, buildings, piling

and foundations, reinforced concrete, utilities. Three years college teaching. Prefers Southeast and Latin America. Me-786.

Process Engineer, Mechanical, BME, MS Management, PE; 37; improvement, development, operation, start-up, construction of equipment for production, coating, impregnating, handling plastics. Ammunition handling, packaging. Web handling, mixing, drying, curing, air conditioning, packing, storing, supervision of personnel. $12,000. Prefers Northeast. Me-787.

Management, Production Engineer, BSAE-ME; supervisor in high-speed production, application of predetermined time standards, time-and-motion study instruction, project engineering, sales engineering including cost estimating and reviewing. $11,000. Prefers New York City or northern N. J. Me-788.

General Manager, BSME; 45; 23 years' experience in precision-parts manufacturing, metal working, and fabrication. Proved record as chief engineer, plant manager, and executive vice-president. Registered PE (Industrial). Advanced Management Training. Location optional. Me-789.

Senior Development Engineer, MSME; 32; ten years' experience in design and development of small complex electromechanical mechanism and instruments; down-to-earth feel for mechanisms, their problems, and solutions. Formerly on C.C.N.Y. faculty; PE in N. Y. $10,000. Prefers New York area. Me-790.

Engineering Manager or Department Head, ME, PE; 36; 15 years' experience in all phases of design and construction of chemical-processing plants and equipment, five as department head. $15,000. Prefers Midwest or South. Me-791.

Human Factors Research or design of medical equipment, graduate mechanical engineer, June, 1959; presently in U. S. Army; to be released March, 1960. $5000. Location optional. Me-792.

Sales Engineer, BME; experience in project-engineering department of a manufacturing firm. Design, development, and testing of new products. Desires opportunity in sales field. $6000. Prefers East. Me-793.

Stress Analyst, BME; seven months' experience in stress analysis on jet engines; five years teaching mechanics: Strength of materials, statics, dynamics, materials testing, and fluid mechanics laboratories; two years airframe-manufacturing methods. Prefers New York or vicinity. Me-794.

Test Engineer, BME; research and development of high-temperature hydraulic components. Specifically setting-up and conducting environmental tests. E.I.T. in N. Y. State. $7500. Location optional. Me-795.

Production Engineer, BME; one year's experience in method improvement on production of plastic film; sheet-metal and precision-casting experience. $6500. Prefers New York Metropolitan area. Me-796.

Chief Manufacturing Engineer, BS; 25 years' experience in production engineering and plant organization. Organizer and developer of facilities and production methods. Strong in cost reduction, safety, and maintenance. Manufacturing experience metal processing, machine tools, plastic products, chemical and explosive processes. $10,000–$12,000. Prefers East or South. Me-797.

Mechanical Engineer, BME, MS; five years' experience in engineering including four years in manufacturing operations. Design and development of small and medium-sized equipment used for production purposes. $8000. Prefers Northeast. Me-798.

Chicago Office

Vice-President in Charge of Sales or General Sales Manager, BSME; 41; seven years engineering large industrial equipment; 13 years as sales engineer and sales manager of company manufacturing heavy industrial equipment. R.E., Ohio and Wis. Location optional. Me-1042-Chicago.

Machine Design or Development Engineer, BSME; 32; seven years' experience design and development of jet engine-accessory gearboxes, from preliminary design through to field-failure analysis. Work includes study of turboprop-reduction gearboxes and related accessories; starters, pumps, etc., and up-to-date knowledge of lubrication methods. Prefers Midwest or East. Me-1043-Chicago.

Senior Mechanical Engineer, BSME; 34 ten years' experience; seven years in furnace-black plant design, maintenance, and construction Experienced in piping, pneumatic conveying, pelletizing, refractories, vessel design, and instrumentation. Prefers Texas, Gulf Coast, or Foreign. Me-1048-Chicago.

Additional listings of positions and men available are maintained in the offices of E.S.P.S. Direct inquiries to nearest office. A weekly bulletin of engineering positions open is available at a subscription rate of $3.50 per quarter or $12 per annum for members; $4.50 per quarter or $14 per annum for nonmembers, payable in advance.

Engineering Administration, Sales, or Personnel, BSME; 27; total of five and one half years' experience in design, development, and project engineering; four years with large manufacturer of rubber products, and one and one half years with aircraft manufacturer. Young engineer with good industrial background desiring to move into administrative-type position. No preference as to location. Me-1049-Chicago.

Design Engineer, BSME; 30; four years in design of experimental combustion-equipment test set-ups, involving equipment for air and liquid-flow measurement, piping, thermoelectric pyrometery, aerodynamic piezometry, and heat transmission. Prefers Gulf Coast, Fla. to Texas. Me-1050-Chicago.

Product Engineer, BSME; 29; three years project engineer on pilot plants; four years product design on pressure vessels; and application engineering for sales department. Salary unimportant; advancement opportunities important. Location immaterial. Me-1051-Chicago.

San Francisco Office

Consultant or Chief Designer, ME; 53; registered ME, Calif. Seven years' experience in charge of design, engineering on structural, machinery, air conditioning for plants, mechanical for airports, radar-truck chassis, cooling equipment for radar manufacturer. Ten years consultant to architects on structural, air-conditioning design. $10,200. Prefers western U. S. Home: San Francisco Peninsula. Se-755.

Industrial Engineer, IE; 27. Solid academic training plus three years' general industrial-engineering and administrative experience. Good record with people, handle reports, correspondence with facility. $7800. Prefers Calif. Home: Calif. Se-714.

Design, Development Engineer, ME; 36. Design, layout, test of small centrifugal pumps, jet pumps, control valves, water-system accessories, and globe and gate valves. Prototype test and development, troubleshoot field problems, installation and operation manuals. $7200. Prefers San Francisco East Bay. Home: Calif. Se-695.

Plant Engineer, graduate. Experience in industrial plant work as plant manager, department manager, manager of construction, superintendent of construction, specification writer, designer, chief draftsman, yard foreman, millwright. $7800. Prefers Midwest. Home: Ala. Se-1255.

Designer, ME (Argentina); 26. Experienced on mechanical design of pressure vessels, heat-exchange condensers, coolers, piping, towers, tanks. Select materials, ASTM, ASME, ASA codes, supervise draftsmen. Salary open. Prefers Calif. Home: Calif. Se-605.

Chief Engineer, ME; 43. Over 20 years' varied manufacturing, consulting and construction experience. Solid background of supervision and administration functions, client contact and contract negotiations, government, and other. $12,000–$15,000. Any location. Home: Ariz. Se-602.

Project Engineer, ME; 29. Solid technical training, plus two years' petroleum-refining-liaison experience and one year's refinery inspection and maintenance experience. Desire challenging engineering work requiring technical problem solution, technical advising, reporting. $6700, plus. Prefers Pacific Northwest. Home: N. Y. Se-568.

Designer, Production Engineer, ME; 23. Experienced in consulting mechanical engineering; dependability, able to meet people. Desire and willingness to learn. $6000. Prefers Southwest. Home: Texas. Se-538.

Designer, MSME; 42. Professional ME license; 20 years' varied experience; 15 years machine, process equipment, and marine piping design, remainder in research, sales, inspection, and test. Good gadget designer. $9600. Prefers dry climate. Home: Wash. Se-291.

Chief Manufacturing Engineer, ME; 37; 14 years' experience manufacturing, development, product design, etc. Fields include ordnance, telegraphic communications, TV assembly, welding fitting, and jet aircraft production. $10,800. Prefers West, Midwest. Home: Pa. Se-198.

Plant Engineer, ME; 54; 18 years construction of facilities, maintenance, and operation of air-bases for government; also survey of machine tools in heavy industry for production of war materials and equipment. Four years machine design, supervising installation in aluminum rolling mill, general plant engineering. PE license, Ariz., Ohio. $9000. Prefers San Francisco Bay area or Foreign. Home: Ariz. Se-174.

Office or Industrial Management, ME, LLB; 36. Six years negotiation, preparation and obtain contracts, develop properties for gas company, and administer office and prepare budget for state government. One year petroleum-plant design, operation. Five years Captain in Air Force as legal officer. Two years repair of equipment for transportation company. $10,000. Prefers West. Home: Colo. Se-395.

Management, Test or Development, ME; 41. Assistant regional and district manager in diesel-engine sales, pipe and boiler insulation sales, and sales engineering. Operations engineer in captive missile or captive missile engines. Salary open. Prefers West Coast. Home: Calif. Se-370.

Positions Available

New York Office

Production Controls Engineers, experience in production control and related activities such as traffic and expediting. Will consider recent college graduates with or without technical degrees. Salaries: for an experienced production-control engineer, $7800–$8400; for recent graduates competitive with leading firms throughout the United States. Company negotiates relocation and agency fees. Upstate N. Y. W-8595.

Production Engineers for a manufacturer of die cast and metal-stamped automotive-accessory parts. (a) Die cast production engineering, mechanical graduate preferred, experience in tooling, estimating, manufacturing of die cast zinc/aluminum parts. (b) Sheet-metal production engineering, graduate mechanical preferred, experience in designing, tooling, and getting tools into production. Company will negotiate relocation and agency fees. Ohio or upstate N. Y. W-8594.

Engineering Editor for a fast growing magazine in the metalworking field; require an engineer to work as assistant editor; sound technical background and at least two years' experience in the metalworking industry. $7500. Boston, Mass. W-8592.

Administrative Engineer for large engineering organization; to work in the semitechnical field of engineering. Some experience in the automotive, aeronautical, or electronics field in systems and procedures desired. Responsibilities will include direction of budget planning, establishing procedures, recruiting, drafting, training, and personnel-administration activities. Lower Conn. W-8590.

Teaching Personnel for general engineering department of a university; MS in a branch of engineering, or interested in work toward MS, or PhD. Must be interested in teaching. Midwest. W-8578.

Senior Industrial Engineers for positions at management level. (a) Industrial engineer in the field of indirect standards; to supervise the development of a standards program for departments such as tool and die and maintenance. Must be experienced and able to give technical guidance and direction at project level. M.T.M. training desirable. (b) Industrial engineer, experience in the installation of M.T.M. standards program in a direct labor department. Must be an accomplished M.T.M. practitioner capable of giving technical guidance and direction to a group of industrial engineers recently trained in M.T.M. To $9600. Ohio. W-8577.

Mechanical Engineer, at least five years' supervisory machine-shop, sheet-metal, and tooling experience, to be responsible for design for production of special devices and equipment. $8000–$10,000. Conn. W-8576.

Chief Engineer, graduate mechanical preferred, but will consider chemical engineer if mechanical experience; to take charge of small engineering department and product-inspection department.

Keep Your ASME Records Up to Date

The ASME Secretary's Office depends on a master membership file to maintain contact with individual members. This file is referred to countless times every day as a source of information important to the Society and to the members involved. All other Society records are kept up to date by incorporating in them changes made in the master file.

The master file also indicates the Professional Divisions in which members have expressed an interest. Many Divisions issue newsletters, notices of conferences or meetings, and other material. You may express an interest in the Divisions (no more than three) from which you wish to receive any such information which might be published.

Your membership card includes key letters, below the designation of your grade of membership and year of election, which indicate the Divisions in which you have expressed an interest. Consult the form on this page for the Divisions to which these letters pertain. If you should wish to change the Divisions you have previously indicated, please so notify the Secretary.

It is highly important to you and to the Society to be certain that our master file indicates your current mailing address, business or professional-affiliation address, and interests in up to three Professional Divisions.

Please complete the form, being sure to check whether you wish mail sent to your residence or office address, and mail it to ASME, 29 West 39th Street, New York 18, New York.

Please Print **ASME Master-File Information** ______ Date

LAST NAME ______ FIRST NAME ______ MIDDLE NAME ______

POSITION TITLE ______ NATURE OF WORK DONE ______

e.g., Design Engineer, Supt. of Construction, Manager in Charge of Sales, etc.

NAME OF EMPLOYER (Give name in full) ______ Division, if any ______

*☐ EMPLOYER'S ADDRESS ______ City ______ Zone ______ State ______

ACTIVITY, PRODUCT, or SERVICE OF EMPLOYER; e.g., Turbine Mfrs., Management Consultants, Oil Refinery Contractors, Mfr's. Representative, etc.

*☐ HOME ADDRESS ______ City ______ Zone ______ State ______

☐ PRIOR HOME ADDRESS ______ City ______ Zone ______ State ______

* CHECK "FOR MAIL" ADDRESS

I subscribe to

Address changes effective when received prior to:

- ☐ Mechanical Engineering — 10th of preceding month
- ☐ *Journal of Engineering for Power*
- ☐ *Journal of Engineering for Industry*
- ☐ *Journal of Heat Transfer*
- ☐ *Journal of Basic Engineering*
- ☐ *Journal of Applied Mechanics* — 20th of preceding month (for the Journals above)
- ☐ *Applied Mechanics Reviews* — 1st of preceding month

Professional Divisions in which I am interested (no more than *three*) are marked X.

☐ A—Aviation	☐ J—Metals Engineering	☐ S—Power
☐ B—Applied Mechanics	☐ K—Heat Transfer	☐ T—Textile
☐ C—Management	☐ L—Process Industries	☐ U—Maintenance and Plant Engineering
☐ D—Materials Handling	☐ M—Production Engineering	☐ V—Gas Turbine Power
☐ E—Oil and Gas Power	☐ N—Machine Design	☐ W—Wood Industries
☐ F—Fuels	☐ O—Lubrication	☐ Y—Rubber and Plastics
☐ G—Safety	☐ P—Petroleum	☐ Z—Instruments and Regulators
☐ H—Hydraulics	☐ Q—Nuclear Engineering	
☐ I—Human Factors Group	☐ R—Railroad	

Will be responsible for product design, material specifications, design of special machines and equipment used in manufacturing. Some stress work. Knowledge of various bearing materials and steels. $10,000. Philadelphia, Pa. W-8575.

Sales Manager, engineering graduate, at least five years' supervisory field sales, sales promotion, market research, and product-development experience in thermoplastic molding and impregnated fields. $10,000–$15,000. Mich. W-8570-

Senior Engineer, Indirect Labor Measurement, college graduate, experience in installing and administering work-measurement and wage-payment plans in the indirect labor area; includes maintenance crafts, janitorial, transportation, warehousing, etc. Will act as consultant to operating components throughout U. S. and will assist and advise on installing work-measurement programs. Travel 50 to 75 per cent of time. Headquarters, upstate N. Y. W-8569.

Engineer, training or experience in efficiency and time-study work; material-handling and construction-procedures experience valuable. Position is with a firm of engineers and contractors. Md. W-8551.

Senior Design Engineer, graduate mechanical, five to 15 years' experience in the design and/or field operation of heavy material-handling equipment such as ore bridges and unloaders, cranes, hoists, and other similar heavy handling equipment. Will have supervisory responsibilities. $10,000–$12,000. Company pays placement fee and relocation expenses. Western Pa. W-8549.

Engineers. (a) Batch facility engineer, graduate mechanical preferred, five to eight years of extensive experience in the design and application of bulk handling and processing equipment such as belt conveyers, bucket elevators, weight hoppers, scale equipment, feeders, mixers, etc. Will work on design and application of essentially all batch-material handling, storing, weighing, mixing, conveying, etc. (b) Project engineer, materials handling, graduate mechanical or industrial, five to eight years' extensive experience with materials-handling equipment such as roller systems, hoists and cranes, mobile equipment such as lift trucks, tractors, etc. Experience in plant layouts, time standards, work sampling desirable but not required. Will analyze problems in materials handling. Upstate N. Y. W-8546.

Assistant General Manager, at least ten years' supervisory production and plant-engineering experience in cement mills. Caribbean area. F-8544.

Project Engineer, graduate mechanical, five years' industrial experience in one or more of the following areas: Machine design, automatic machines, and/or packaging machines. Duties and responsibilities will include trouble shooting, machine design and modification, co-ordination, and follow up of assigned projects, etc. $8500–$10,000. Central N. J. W-8541(a).

Methods, Process, Production Engineer, graduate mechanical, to assist the general manager on all mechanical problems in operating a woodworking plant making furniture. To $10,000. N. C. W-8524.

Chief Industrial Engineer, IE or ME graduate, at least five years' supervisory industrial experience in paper-converting fields. $12,000–$15,000. South. W-8521.

Personnel for Industrial-Relations Department. (a) Assistant to industrial relations manager, degree minimum requirement, graduate degree preferred, several years' experience in industrial (labor) relations especially as applied to last step grievances, arbitration, and negotiation procedures, etc. Experience should have been in a relatively large-sized manufacturing company. $10,800–$13,200. (b) Staff assistant, undergraduate degree required, graduate degree preferred, two years' minimum experience in labor-relations field. $6900–$9600. New York suburban area. W-8514.

Engineers. (a) Industrial engineer, graduate, methods, production, and scheduling experience in cutlery or hardware fields; $8000–$9000. (c) Design engineer, mechanical graduate, experience on packaging machinery. $8000–$10,000. N. J. W-8502.

Chief Industrial Engineer, BS in engineering minimum, good experience in the area of work measurement, development of standard-data and work-sampling techniques. Will be responsible for planning, establishing, and directing a management-engineering group that will conduct organizational planning, cost-reduction program, systems and procedures studies, and related activities. To $18,000. Must be U. S. citizen. Upstate N. Y. W-8494.

Engineers for an engineering and construction firm. (a) Project engineers, graduate mechanicaal

minimum of five years' experience in the design of steam-electric power stations involving project interoffice and client co-ordination. Salary commensurate with experience and ability; liberal company benefits. (b) Specifications writer, graduate mechanical, familiar with specifications and report writing for central station, industrial and chemical work. Salary commensurate with experience and ability; liberal company benefits. Eastern Pa. W-8486.

Engineers. (a) Industrial engineer, mechanical graduate, capable of assuming responsibilities of project engineer, minimum of three years' experience in industrial engineering on small punch-press work and high-speed assembly machinery. Knowledge of heat-treating, plating, and general machine trade desirable. $9500. (b) Junior process engineer, two to four years' engineering education plus experience in time-and-motion study, methods analysis, estimating, machine-shop practice, plant layout, and manufacturing routine. $7000. Company pays placement fees and relocation expenses. Western Pa. W-8460.

Engineer, Plant Facilities, solid background in construction development and management. Some background in structural or architectural work on board helpful. Will be involved in new construction and maintenance of existing facilities. To $9600. Company pays placement fee and relocation expenses. Western Pa. W-8459.

Mechanical Engineer, graduate, experience in automatic metal-bending and forming equipment. Must successfully have filled production supervisory positions. Opportunity for advancement to mill superintendent. $10,200–$12,000. East. W-8456.

Engineers. (a) Plant superintendent for a firm manufacturing institutional furniture and case goods; 500 employees. Should be experienced production man and have a good tool and die background. Conn. (b) Plant superintendent, experience similar to afore-mentioned for company plant manufacturing desks and partitions. Upstate N. Y. (c) Plant superintendent, experience similar to afore-mentioned, for company plant manufacturing shelving. Pa. (d) Research and development engineers to work with designs in developing production from the design stage to the prototype. Various locations. All applicants should, preferably, have experience in metal furniture or related fields but will consider general metal experience. W-8445.

Senior Research Engineer, strong background in applied mechanics or applied mathematics and a knowledge of viscoelastic stress analysis and/or large deformations. PhD with experience preferred. Must be able to initiate and implement basic study of the shaping of hot glass and stress analysis in glass. Salary open. Company pays placement fee. New laboratory. Western Pa. W-8170.

Senior Engineer, Applied Mechanics, recent graduate MS or PhD, or several years' experience. Analytical ability desired. Position is with small consulting firm doing business in wide variety of fields, including missile and submarine-vibration problems. Relocation costs paid. Mass. W-8149.

Technical Writer, preferably an engineer, to write copy and prepare sales bulletins and similar literature; previous experience in the refrigeration and air-conditioning industry desirable but not mandatory. Prefer someone who is interested in the field of industrial advertising. Mo. W-8064.

Engineers, either recent graduate engineers in mechanical engineering, major in field of refrigeration and air conditioning, or those with experience in the industry for several years. Positions are principally of application of accessory items to refrigerated equipment of all sizes. Practical on the job-training program after which applicants will be sent to other areas. Salary plus a bonus arrangement plus all expenses. Headquarters, Midwest. W-7943.

Chicago Office

Production, Product, Project Engineer, BSME; four years' experience in design, experimental laboratory in automotive-type products, know hydraulics, instrumentation. Duties: Project engineer to trouble shoot hydraulic pumps, fan drives, locking differentials. Involves working with customer, test laboratory, design and production personnel. Knowledge of fluid flow, lubrication, metallurgy, automotive-type products, production process desirable; for a parts manufacturer. $7800–$10,200. Employer will negotiate placement fee. Mich. C-7933.

Chief Industrial Engineer, BSME or IE, mechanical outlook. Eight years' or more industrial-engineering experience. Duties: Should have mechanical aptitude and highly analytical mind. Must know plant and machinery layout and work simplification plus knowledge of tool and die design, time and work standards. Must be a leader; for a manufacturer of electrical equipment. Employer will pay placement fee. Chicago, Ill. C-7915(a).

Assistant or Associate ME Professor, MSME, plus experience. To teach courses in thermodynamics, heat transfer, and fluid flow together with developing and teaching of mechanical laboratory. There is expected in the future increased activity in graduate study with required necessity for graduate-level supervision. Contract for 12 months with time available for professional development. Ill. C-7643.

San Francisco Office

Design Draftsman, to 50. Five to six years' experience on special machinery and equipment (screw conveyers, crushers, packing equipment, mills, cranes, monorails, hoists). Able to prepare mechanical design and draft. Knowledge of mechanical elements and electric controllers desirable. $6600–$7200. San Francisco. Sj-5043.

Assistant Designer, graduate ME and two years' experience on servo system design. For new structural design, steel and aluminum, servo system and basic electrical and electronic work. $6672–$8112. San Francisco East Bay. Sj-5041.

Mechanical Designer, ME, 25–35. Five to ten years design of mechanical construction, some experience cost estimating, specifications, contracts, field supervision of construction. For planning of machinery layout, changes and major repairs, complete working drawings of equipment layouts, cost estimates, contracts, and specifications for construction-field supervision and inspection of contractor's work on equipment installation. $6000–$7200. Employer pays placement fee. Northwest. Sj-5038-R.

Senior Industrial Engineer, graduate ME or EE. Experienced in industrial work. Should be experienced in human engineering, work measurements, method studies; to develop new improved system, new concepts and design of equipment for postal services; work closely with postal employees, co-ordinate (not a time-study job). $8400–$12,000. For a manufacturer. San Francisco Peninsula. Sj-5037-R.

Chief Estimator, graduate, 30–45. Experienced in take-off, labor, and material pricing for heavy industrial construction-bid preparation. Experience in steel plant bidding essential. At least ten years including estimating, flow-sheet information to complete bidding documents, magnitude estimates through lump sum bids. Direct estimating department, material take-off, and labor and material pricing on piping, mechanical, structural steel, excavation, concrete and architectural trade work, handle paper work, familiar with scheduling construction and estimating departments. $9600–$14,400. Headquarters Chicago. Sj-5035.

Sales Engineer, sound commercial background, well experienced in direct sales to customers (industrial, business, or commercial); technically sound in heating, ventilating, air conditioning on commercial and industrial types. Will provide initial contact, design as required, maintain client engineering contact, estimate and provide installation guidance. For a manufacturer's sales office. Car required. $10,000–$12,000. San Francisco Bay area. Sj-5034.

Sales Engineer, ME or equivalent. Experienced in selling to and furnishing application engineering information to consultants, heating and ventilating contractors, plant engineers on forced air movement, air volume filters, primarily heavy commercial or industrial applications. Should be able to figure jobs, estimate costs and deal with clients from beginning to finish. For manufacturer's representative. $6000, company car and expenses against 20 per cent commission. Potential for $10,000. San Francisco Bay area. Sj-5033.

Engineering Designer, degree or equivalent. Minimum three years' experience on heating, ventilating, air conditioning and/or plumbing. Must be well experienced and able to perform independently on job and commercial-type work including schools and hospitals. Able to translate design thinking into board plans. Employer will consider payment of relocation cost and placement fee. $7800–$9000. Headquarters, Sacramento. Sj-5008-R.

Mechanical Designers, ME, heavy on theory, to 45. Experienced in servo systems and components, treat and actual application design with knowledge of servo systems, actuators, and controls. Completely informed regarding pressure drops and fluctuations, accumulation, surges and impact pressures. Able to work with mechanical and electronic design for manufacturer of simulator equipment. U. S. citizen. Salary open. San Francisco Peninsula. Sj-4985-R.

Engineers. (a) Product designer, graduate ME, minimum five years production design, 30–35. Design products to customer requirements; machinery, steel, gears, transmissions, power drives; for manufacturer. $7800–$8400. (b) Draftsman, tracer. Experienced in structural steel work. About $5400–6300. San Francisco Peninsula. Sj-4914.

Junior Mechanical Engineer, recent graduate, for training. Leading to assignment as design engineer on mechanical, such as conveyers, heavy equipment, plant engineering. Salary open. Southern Calif. Sj-4990-R.

Chief Operating Officer, graduate or equivalent, about 45. Well qualified by verifiable recent and extensive experience in all phases of general manufacturing management (shop, sales, fiscal) of a large division of industrial corporation complex. Must be knowledgeable in heavy steel fabrication on the national scene and be able to initiate action, engage in and/or direct business contacts with contractors, engineering-builders, governmental agencies, architects, engineers, and carry out operational activity with company top personnel in management, fabricating and machining shops, sales, controllers, and planning. Apply by letter of application. For national manufacturer. $20,000–$30,000, incentives. Western location. Sj-5006.

Mechanical Designer, graduate, 30–45. Five to ten years' experience in fertilizer or heavy chemical industry. For design of piping, pressure vessels, mixing equipment, selection of conveyers, agitators, general processing equipment, for chemical plant from process flowsheets. Salary open. Central Calif. Sj-4999.

Designer, ME, to 45. Minimum five years' experience involving mechanical stress analysis, drafting layouts, some drafting, knowledge of sheet-metal shop fabrication, machine shop practices, assembly. Will assist in design, development of automotive electrically operated lifts, towers, booms, and accessories for material handling. Work involves dealing with structural, mechanical, electrical, and some body and chassis work. For a manufacturer. To $8400. San Francisco Peninsula. Sj-4993.

CANDIDATES FOR MEMBERSHIP AND TRANSFER IN ASME

The application of each of the candidates listed below is to be voted on after March 25, 1960, provided no objection thereto is made before that date and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the Secretary of The American Society of Mechanical Engineers immediately.

New Applications and Transfers

Alabama

Landrum, J. Porter, Sr., Birmingham
Wilson, Earle F., Jr., Brewton

Alaska

Rhodes, Guy W., Fort Yukon AFS

Arizona

● Jeppesen, Lyle R., Tucson
Tesmer, Arthur W., Glendale
Van Sice, Edward R., 3rd, Tucson

California

Boyle, William W., China Lake

●Transfer to Member or Affiliate.

Kobayashi, Arthur, Rancho Cordova
Kress, Ralph, La Mesa
●Levinson, Norman J., Los Angeles
●Nielsen, Andrew K., San Francisco
Raymond, Robert J., Los Angeles
Schuetz, Phillip H., Jr., San Diego
Semenenko, Alexander S., San Francisco
Shyne, Kevin T., Reseda
Susnir, John, Granada Hills
Tsui, Edward Y. W., Sunnyvale
●Wolf, James E., Reseda
Zweifel, Martin C., National City

Colorado

●Stephens, John L., Denver
Williams, Bert O., Denver

Connecticut

Brennan, William H., Waterbury
McLaughlin, Donald W., Middletown
Nemergut, Paul J., Jr., Stratford
●Parrella, Alfred T., Ansonia
Sicard, Clarence, Cheshire

District of Columbia

McConnell, Brian P., Washington

Delaware

Erdelyi, Edward A., Newark
Jordan, Thomas F., Wilmington
Madora, Albert W., New Castle

Florida

Christian, Donald L., Miami
Dinkler, Leonard R., Dunedin
Holzmann, William N., Gulf Breeze
Worlund, Armis L., Pensacola

Hawaii

Soderholm, Nels L., Jr., Kailua
Yuen, LeRoy B. C., Honolulu

Illinois

Danielson, Worrell M., Evergreen Park
Kinnavy, Martin G., Oak Park
Kranz, Robert L., Mt. Prospect

Indiana

Borgman, John D., La Porte
Pearce, Paul G., Indianapolis
Remillard, Alfred P., Lawrenceburg
Scales, Maurice L., Indianapolis
Stein, Marcel, Valparaiso
Taylor, John W., Jr., Fort Wayne

Iowa

Glazer, Milton L., Sioux City
Shreeves, Robert W., Iowa City

Kansas

Newsom, Calvin D., Wichita

Kentucky

Sapp, Julian F., Louisville

Louisiana

Kendall, William W., Metarie
Lockett, Thomas B., New Orleans

Maryland

●Wroten, John F., Jr., Baltimore

Massachusetts

Baumann, Hans D., Sharon
●Carlin, Thomas R., Westboro
●Drinker, Pemberton H., Foxboro
Fisher, John C., Cambridge
Kropta, Milos, Lenox
Martindale, William H., Northboro

Michigan

Barretta, Val S., Dearborn
Bozzola, Riccardo, Fenton
Hoekstra, Herbert J., Detroit
Kuthe, Charles H., South Lyon
Magnuson, Thomas D., Jackson
Wolf, Maurizio A., Detroit

Minnesota

Possis, Zinon C., Minneapolis

Mississippi

Burguet, Jorge E., Jackson

Missouri

●Barr, Robert W., Springfield
●Bertelson, Peter C., St. Louis
Grindley, Willard F., Kansas City
Minnich, Charles B., Kansas City
●Weber, Walter H., St. Louis

Nebraska

Wozny, Jerome L., Omaha

New Jersey

Becker, William, Union
Canova, Fred, Phillipsburg
●Collins, John F., New Providence
Faiella, Alfonse J., Newark
●Gottilla, Salvatore C., W. Caldwell
Stahl, Arthur F., Englewood

New York

Bondar, Charles K., Glen Cove
Bower, Kenneth J., Staten Island
Brodoff, Bernard, New York
●Dallen, Myron F., Jr., Garden City
Erickson, William T., 3rd, New York
Fitzgerald, James E., Niagara Falls
Fruehauf, Roy R., Orchard Park
Jennings, James F., Jr., New York
●Johnson, David W., Schenectady
●Kennedy, Ambrose, Poughkeepsie
Kenney, John E., New York
Kunsagi, Laszlo, Brooklyn
●Owczarek, Jerzy A., Schenectady
Roark, Michael A., Forest Hills
Schneider, John W., West Seneca
Stevens, Harry E., Albany
Weiss, Harold J., Jamaica
Williams, Bruce E., White Plains
Wu, Wen S., Wappingers Falls

Ohio

Ebersold, Robert C., Cleveland
Erickson, Laverne E., Wickliffe
●Johnson, Howard B., Jr., Lima
Keresman, Michael A., Jr., Parma
Kinnavy, Roger J., Salem
●Osborn, David B., Cincinnati
●Sealey, Philip T., Dayton
Thomas, James W., Cleveland
●Wasik, Henry J., Massillon
●Wolansky, John, Willowick

Oklahoma

May, Eugene J., Oklahoma City
Smith, Robert L., Tulsa

Pennsylvania

Donato, Joseph W., Norristown
Falb, Alec, Pittsburgh
Fritz, William A., Jr., Springfield
●Heymann, Frank J., Philadelphia
Lombardo, Sylvester, State College
Maccary, Raymond R., Export
McMullin, John G., Pittsburgh
Sajben, Miklos, Media
Szebehely, Victor G., Philadelphia

South Dakota

Seversky, Moses D., Brookings

Tennessee

Crowe, James N., Knoxville
Price, John S., Bristol

Texas

Henderson, William R., Jr., Houston
●Juenger, Edward C., Pampa
●Kruemcke, Paul M., Houston
Raulins, George M., Houston
Redmon, Billy L., Houston

Virginia

Craddock, Thomas E., Jr., Altavista
Howard, James H., Alexandria
Pennisi, Gerald R., Arlington

West Virginia

Barna, Peter, St. Albans

Wisconsin

Russell, Harold D., Beloit

Foreign

Bramer, Kenneth E., Niagara Falls, Ont., Canada
●Crittenden, Calvin C., Barcelona, Venezuela
Cumming, John G. S., Trinidad, W. I.
Demain, Wilson C., Kingston, Jamaica, W. I.
Fulford, Phillip J., Winnipeg, Man., Canada
Haque, Mohammad S., London, England
Huang, Donald Y. W., Hong Kong, China
Lacy, Garry T., St. Eustache, P. Q., Canada
●Marris, Andrew W., Vancouver, B. C., Canada
Minocher, Howie D., Jalna, Deccan, India
Robinson, William H., Labrador, Canada
Shah, Mahesh M., Bombay, India
Suezawa, Yoshitada, Tokyo, Japan
Tello, Joaquin, Bogota, Colombia, S. A.
Van Doeland, Oth J., Amstelveen, The Netherlands
Volling, Fritz, J. M., Toronto, Ont., Canada

OBITUARIES

Clarence E. Armstrong (1880–1959), controller, Great Southern Corp., Corpus Christi, Texas, died Jan. 6, 1959. Born, Newark, N. J., Aug. 19, 1880. Education, high-school graduate. Assoc. Mem. ASME, 1922; Mem. ASME, 1935.

George Innes Bouton (1873–1959), retired, formerly with D. P. Brown and Co., Detroit, Mich., died Dec. 1, 1959. Born, St. Louis, Mo., March 1, 1873. Parents, William and Mary R. (Conklin) Bouton. Education BS(EE), Washington Univ., 1894. Married Honora Blakley, 1909 (d. 1957). Assoc. Mem. ASME, 1901; Mem. ASME, 1904. Survived by two children, Innes Bouton, Inglewood, Calif., and Mrs. Gene Kosolapoff, Auburn, Ala.; and a sister, May Innes Bouton, St. Louis, Mo.

Jerome Bauduy Corby (1875–1959), president, Corby Supply Co., St. Louis, Mo., died Aug. 1, 1959. Born St. Louis, Mo., May 21, 1875. Parents, Francis P. and Josephine A. Corby. Affiliate ASME, 1921. Mr. Corby had organized the Corby Supply Co., in 1907.

John Darby (1867–1959?), whose death recently was reported to the Society had been an inventor and machine designer. Born, Washington, D. C., May 2, 1867. Parents, Benjamin and Caroline (Collier) Darby. Education, ME, Stevens Institute of Technology, 1891. Married Caroline L. Carpenter, 1895 (d. 1932); children Walton C. (died 1920) and Katherine R. (Mrs. E. F. Flindell). Mem. ASME, 1907. Mr. Darby held a number of patents. He was a specialist in the field of industrial engineering, covering studies of plants for improvements in equipment, methods, and processes, and the design of special machinery.

John Paul Dearasaugh (1892–1959?), plant engineer, Aluminum Company of America, Point Comfort Works, Texas, died recently according to a report received by the Society. Born, Little Rock, Ark., Sept. 6, 1892. Parents, Joseph and Katherine W. Dearasaugh. Education, high-school graduate. Married Ethel Alley, 1912; daughter, Ethel Mary. Mem. ASME, 1929. Mr. Dearasaugh had been with Alcoa since 1920.

Anton Hansen (1881–1959), assistant engineer, firm of Richard P. Hansen, San Benito, Texas, died recently according to a report received by the Society. Born, Odense, Denmark, April 26, 1881. Parents, Peder and Kirsten (Jensen) Hansen. Education, attended public and technical evening schools and Alexander Hamilton Institute Course. Naturalized U. S. citizen, Greensburg, Pa., Dec. 17, 1910. Married Antoinette Cargain, 1909; children, Richard P. and Phyllis E. Prior to his semiretirement in 1948, Mr. Hansen had been employed by William Bergfels Co., Newark, N. J. Assoc. Mem. ASME, 1914; Mem. ASME, 1935.

James Conrad Heckman (1877–1959), management engineer, Stevenson, Jordan & Harrison, New York, N. Y., died Dec. 2, 1959. Born, Phillipsburg, N. J., Nov. 4, 1877. Parents, Frank B. and Sarah Alice Heckman. Education, EE, Lafayette College, 1899; postgraduate chemical-engineering study, M.I.T., 1900. Married Ida E. Johnson, 1904; children, Edward T., Alice E., and Mary L. Mem. ASME, 1920. Mr. Heckman served in the U. S. Army during World War I. He attained the rank of colonel and received a Distinguished Service Medal for his plan of an entire scheme of Ordnance Supply Depots having a total cost of nearly $50 million. He was a licensed professional engineer in the State of New York.

Randall James Hogan (1899–1959), retired colonel, U. S. Army, and instructor in mechanical engineering, Pennsylvania State University, York Campus, York, Pa., died Nov. 21, 1959. Born, Chelsea, Mass., Dec. 16, 1899. Education, BS(ME), M.I.T., 1922; MS, 1927. Married Catherine Sheehan, 1925. Colonel Hogan served in the U. S. Army Ordnance Corps for 32 years. Among his honors were the Legion of Merit, Bronze Star, and Order of the British Empire. Survived by his widow; a son, Randall J. Hogan, Jr.; a daughter, Mrs. James J. Flaggert, Jr.; and eleven grandchildren. Member ASME, 1957.

Daniel Calvin Johnson (1910–1959), supervising engineer, Aviation Gas Turbines Div., Westinghouse Electric Corp., Kansas City, Mo., died Sept. 24, 1959. Born, Morven, N. C., Oct. 23, 1910. Education, Univ. of North Carolina, 1942; BS(ME), Duke Univ., 1943; graduate work, University of Pennsylvania; special courses at M.I.T. Mr. Johnson had been in

charge of instrumentation for laboratories and test cells of the Westinghouse Jet Engine facility at Kansas City. Assoc. Mem. ASME, 1944; Mem. ASME, 1958.

David Todd Jones (1864–1959), retired, general manager, Wilbraham-Green Div., Roots Connersville Blower Corp., Pottstown, Pa., died Nov. 20, 1959. Born, Chester County, Pa., June 3, 1864. Parents, David Todd and Elizabeth (Gest) Jones. Education, attended Swarthmore College. Married Marion Rakestraw, 1898; children, Elizabeth G., Mary H., Henry R. Assoc. Mem. ASME, 1898; Mem. ASME, 1904.

Ralph Keller (1906–1959), general manager, Keller Furniture, Oneida, N. Y., died March, 1959. Born, Maspeth, Long Island, N. Y., May 10, 1906. Parents, Frank and Margaret (Hayes) Keller. Education, attended night college, two years. Married Martha Ratke, 1928; three children, Ralph, Paul, Doris. Affiliate ASME, 1956. Mr. Keller served the Society as a member of the Wood Industries Division General Committee, 1946-1948.

Arthur Joseph LaCroix (1883–1959), president, Hyde Manufacturing Co., Southbridge, Mass., died Oct. 23, 1959. Born, Southbridge, Mass., Sept. 7, 1883. Education, high-school graduate, attended Worcester Polytechnic Institute. Assoc. Mem. ASME, 1914; Mem. ASME, 1935.

John H. Lawrence (1886–1959), retired consulting engineer, Murray Manufacturing Corp., Brooklyn, N. Y., died Nov. 21, 1959. Born, Albany, N. Y., Sept. 5, 1886. Parents, Richard and Anna (Galvin) Lawrence. Education, ME, Cornell Univ., 1909. Married Evelyn C. Crotty, 1915. Assoc. Mem. ASME, 1911; Mem. ASME, 1920; Fellow ASME, 1936. Mr. Lawrence held more than 25 patents for improvements in steam power plant design. He served the Society as vice-president, manager, chairman of the Standing Committee on Professional Divisions, chairman of the Power Division, and chairman of the Metropolitan Section. Mr. Lawrence as vice-president, engineering manager, and director of Thomas E. Murray, Inc., was responsible for the design of the New York Edison Co. East River Station, the Hell Gate Station of the United Electric Light & Power Co., the Hudson Avenue Station of the Brooklyn Edison Co., and numerous other power stations, substations, and industrial buildings. Survived by his widow.

Lawrence Francis Leuken (1929–1957), whose death on Nov. 29, 1957 has recently been made known to the Society, had been with E. W. Buschman Co., manufacturers of conveying machinery, Cincinnati, Ohio. Born, Cincinnati, Ohio, June 17, 1929. Education, ME, Univ. of Cincinnati, 1952. Assoc. Mem. ASME, 1952. Survived by his widow, Irene Leuken.

Robert Norman Macalister (1873–1958), retired, formerly with the firm of Robert W. Hunt Co., Chicago, Ill., died Oct. 26, 1958, according to a report recently received by the Society. Born, Detroit, Mich., May 19, 1873. Education, ME, Univ. of Illinois, 1906. Mem. ASME, 1913. Mr. Macalister had been with the Robert W. Hunt Co. from 1906 until his retirement in the 1940's. Survived by M. G. Macalister.

Arthur B. Marsh (1885–1959), retired patent lawyer, formerly with Wright, Brown, Quinby, and May, Boston, Mass., died Oct. 21, 1959. Born, Amherst, Mass., June 15, 1885. Parents, Edward B. and Emma R. (Wiggin) Marsh. Education, BS(ME), Purdue Univ., 1907; master of patent law, Georgetown Univ., 1914. Married Mabel Cisele, 1916; two children, Harold C. and Barbara A. Marsh. Mr. Marsh was a specialist in the area of machine tools, shoe machinery, and shoe construction. Assoc. Mem. ASME, 1920; Mem. ASME, 1935. He was a member also of the American Bar Association and the American Patent Law Association.

Charles Hosmer Morse, Jr. (1873–1959), retired, chairman of the board, Fairbanks, Morse & Co., Chicago, Ill., died Aug. 24, 1959. Born, Chicago, Ill., Aug. 13, 1873. Parents, Charles H. and Martha Jeanette (Owens) Morse. Education, BS, Univ. of Michigan, 1895; ME, 1897. Married Charlotte Ingersoll, 1900. Assoc. Mem. ASME, 1897; Mem. ASME 1904. Mr. Morse retired in 1939. He had been vice-president, E & T Fairbanks & Co., and a director of The Canadian Fairbanks, Morse Co., Ltd., Montreal. He was a director also of American Terminal Co. and of Harris Trust & Savings Bank.

William John Poehlmann (1921–1959), plant engineer, Merck Sharp & Dohme Div., Merck & Co., Inc., West Point, Pa., died Nov. 20, 1959. Born, Philadelphia, Pa., July 27, 1921. Education, BS(ME), Drexel Institute of Technology, 1943. Assoc. Mem. ASME, 1947. Survived by his father, William J. Poehlmann, Sr.

George Ichabod Rockwood (1868–1959), Hon. Mem. ASME, engineer, educator, inventor, and manufacturer, a past-vice-president ASME, and the donor of the Holley Medal, died Oct. 30, 1959. Born, Dorchester, Mass., Jan. 13, 1868. Parents, Edward Otis and Caroline (Washburn) Rockwood. Education, BS, Worcester Polytechnic Institute, 1888; ME, 1898; DE, 1929. Married Ellen Tyler Cheever, 1890 (deceased). Married 2nd, Anna Victoria Outhouse, 1933; children, George I. Jr., and Ellen Victoria. Mem. ASME, 1891; Fellow ASME, 1936; Hon. Mem. ASME, 1948. Mr. Rockwood formed the Rockwood Sprinkler Co. in 1906 to exploit his patents on sprinkler apparatus for fire protection. Among the 25 patents which he held, there were also patents for steam machinery and for a patient-lifting device for use in hospitals. For a period, Mr. Rockwood had been professor of steam engineering and thermodynamics at Worcester Polytechnic Institute. He was a life trustee of that institution and, in 1939, served as its president ad interim. He was the author of numerous papers and of a book, "Cheever, Lincoln and the Causes of the Civil War." Mr. Rockwood served the Society as Manager, 1903–1906; vice-president, 1924-1925; and as a member of a number of other committees. In 1923 he provided an endowment of $6000 to the Society for the establishment of a gold medal, the Holley Medal.

Alex P. Schumann (1899–1959), secretary, The Cincinnati Gilbert Machine Tool Co., Cincinnati, Ohio, died Sept. 25, 1959. Born, Baltimore, Md., Feb. 13, 1899. Education, secondary schools and school of art and science. Assoc. Mem. ASME, 1921; Mem. ASME, 1935. Mr. Schumann was a specialist in the field of radial drills and horizontal boring machines. During World War I he had designed a special gun-boring and turning lathe.

Louis Seutter (1894–1959), whose death recently was reported to the Society, had been a consulting industrial engineer, Milwaukee, Wis. Born, Kansas City, Mo., Dec. 31, 1894. Parents, Charles and Rose Seutter. Education, BS, Univ. of Missouri, 1917; ME, 1918; studied accounting and law. Married Irene Agnes Moe, 1926. Junior ASME, 1918; Assoc-Mem. ASME, 1922; Mem. ASME, 1927. Mr. Seutter was a registered engineer as well as a registered public accountant in the State of Wisconsin.

William Parker Smith (1876–1958), whose death on Dec. 21, 1958, was recently reported to the Society, had been manager, industrial department, Wagner Smith Co., Dayton, Ohio. Born, Dayton, Ohio, Feb. 1, 1876. Education, high-school graduate. Assoc.-Mem. ASME, 1918; Mem. ASME, 1935.

Herbert William Snyder (1881–1959), retired, formerly with Lima Locomotive Works, Inc., Lima, Ohio, died Sept. 12, 1959. Born, Muncie, Ind., Oct. 6, 1881. Parents, John M. and Mary Jane Snyder. Education, BS(ME), Purdue Univ., 1906. Married Laura Frazer, 1917. Mem. ASME, 1917. Survived by his widow.

Stephen Albert Staege (1881–1959?), research and development consultant, Black & Clawson Co., Hamilton, Ohio, died recently according to a report received by the Society. Born, Mattoon, Wis., July 25, 1881. Parents, Albert J. and Emma K. Staege. Education, ICS and home study. Married Elizabeth S. Case, 1914. Mr. Staege held more than 50 patents chiefly on electrical and automatic control systems. He was the author of numerous papers published in the technical press. Mr. Staege had been with Black & Clawson since 1934. Assoc.-Mem. ASME, 1917; Mem. ASME, 1918. He was a fellow of AIEE, a member of TAPPI, and an assoc. mem. of IRE.

Henry Marx, Charter Member of ASME, Dies Feb. 8, 1960

Henry Marx, former president of the G. A. Gray Company of Cincinnati, Ohio, and a charter member of The American Society of Mechanical Engineers, died February 8, 1960, in Cincinnati, at the age of 101. He was the last survivor of the group of engineers who founded ASME in 1880.

Born in Toledo, Ohio, in June, 1858, he attended schools there and in Karlsruhe, Germany. In 1879, he graduated from Cornell University with the degree of Bachelor of Mechanical Engineering.

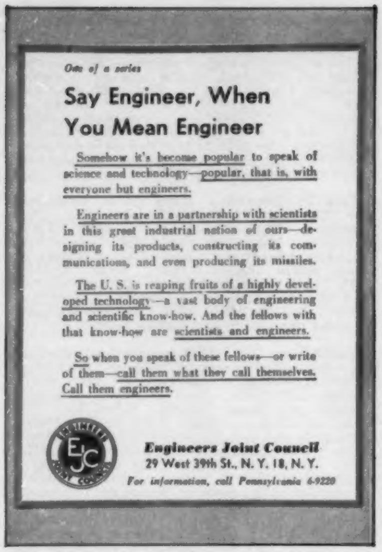
After working for various machine-tool companies, Mr. Marx joined the G. A. Gray Company in 1889 as a general agent and engineer in charge of erecting machinery. In 1905, he became president of the company, which manufactures machine tools, and remained in that post until 1952, when he became chairman of the board. He retired as chairman in 1959.

In 1955, during the year-long celebration of the Society's 75th Anniversary, Mr. Marx was presented with a special certificate and anniversary medal commemorating his 75 years of membership. His citation for distinguished service read in part: "Mr. Marx is the only living member of the group of engineers who, in the year 1880, established The American Society of Mechanical Engineers. It is to this group that we owe the benefits that have come since then to engineers, to engineering, and to society as a whole from the many-fold activities of ASME."

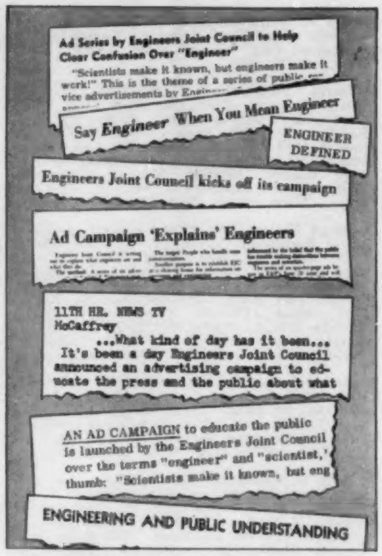
Henry Marx, Charter Member of ASME, who died Feb. 8, 1960

On April 7, 1880, Mr. Marx was elected a junior member at a meeting held at Stevens Institute of Technology, Hoboken, N. J., when some of the country's leading engineers assembled to organize a society for the exchange of information among, and the setting of standards for, those men who designed, built, and applied the mechanical structures which were the heart of the industries then springing up in the United States. He was elected a junior member of the new professional society and a full member in 1892. From the time of his first membership, the Society has grown from less than 100 to more than 58,000 members.

Mr. Marx is survived by a daughter, Mrs. Eames Donaldson; a brother, August, present chairman of the board of the Gray Company; and two sisters, Dr. Ella Marx and Miss Bertha Marx.



Six small advertisements like these . . .



Had this kind of impact.

EJC Ads Aim at Press; Hit Wide Public

In its effort to reach the men who write the news—to tell them some things about engineers—Engineers Joint Council has done even more. Its ad campaign has been brought to the attention of the general public, cited by radio and television newscasters.

At the end of 1959 all six ads in the EJC campaign had run in Editor & Publisher, business magazine of the nation's newsmen. Purpose of the advertisements: to make those who communicate the news more aware of what engineers are and what engineers do.

One object was to help the journalists distinguish between engineers and scientists. Another object was to establish EJC in their minds as the voice of the engineer, prime source of information for them on stories about engineers and engineering.

TV and radio newscasters told audiences of millions that EJC had launched an educational campaign with the theme: "Scientists make it known; engineers make it work."

As the general public got this word of the ad campaign, releases went out to others. Effectiveness of the modest expenditure on advertising space was multiplied as society journals and business papers read by engineers found the ad campaign newsworthy.

Resulting pieces of publicity given the campaign—the radio, TV, magazine and newspaper mentions—can't be assigned a dollar value. But it would be considerable.

Headlines read:

"Ad Series by EJC to Help Clear Confusion Over 'Engineer'"

"Engineers Joint Council Kicks Off Campaign to Recast Your Image"

And the mail came into EJC headquarters:

". . . It is hoped the ads will help news writers and editors to present a better picture of the engineer and what he does."

"Every engineer should become a missionary on this theme."

This modest ad program was done with voluntary contributions from several of the societies within EJC. The Council's 1959 Public Relations budget (about ¼ cent per engineer as opposed to $6.50 per member spent yearly by the American Medical Association) had no money for it. However, the sentiment was there; EJC Secretary E. Paul Lange had ample response to the request for voluntary funds.

The advertising campaign was but one of recent services performed on behalf of the engineering profession by Engineers Joint Council. EJC operates continuous programs and conducts regular surveys of use to the profession, to government and to industry:

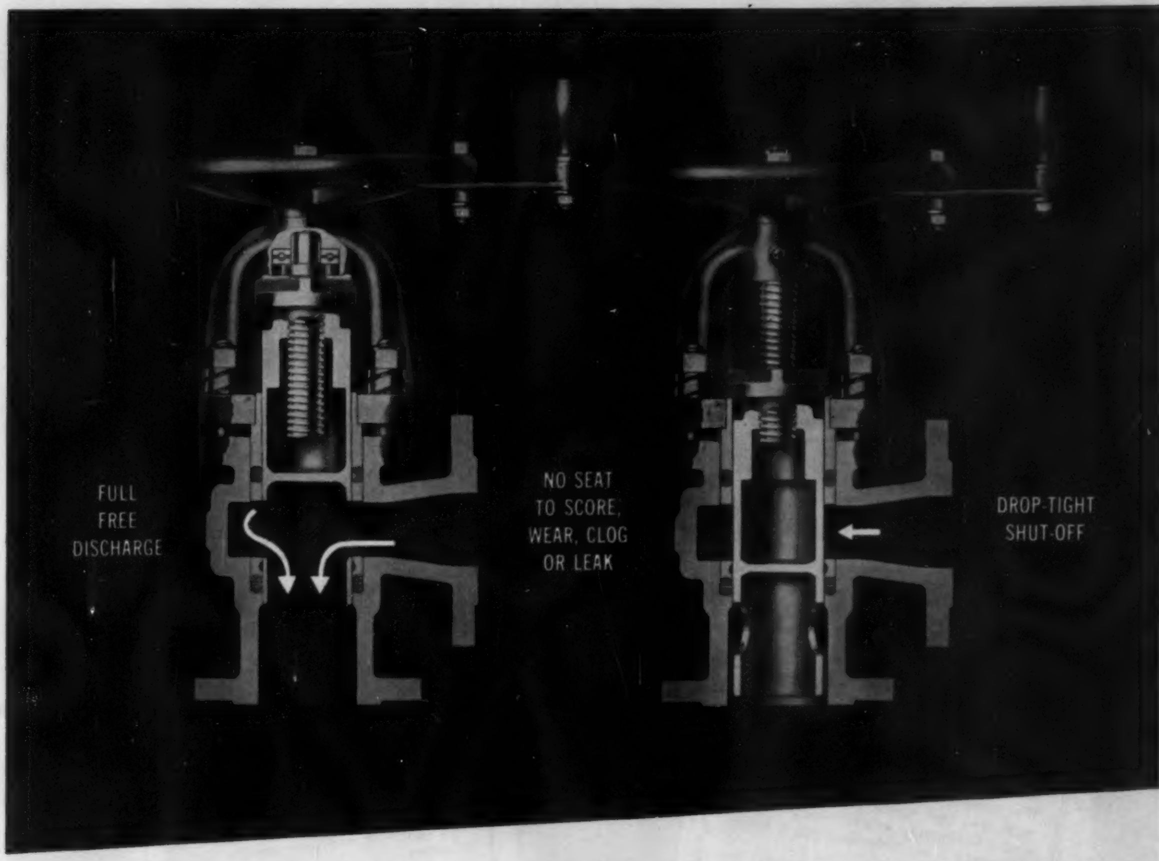
- EJC's Manpower Commission compiles and distributes information on the demand for engineers; it also surveys their salaries.
- EJC is the U. S. representative for Iaeste (international student exchange) and conducts a foreign visiting engineering teacher exchange.
- EJC coordinates the National Nuclear Congress.
- It also is responsible for publishing the Engineering Societies Register and plans a National Engineers Register.

Engineers Joint Council is a federation of engineering societies with a total membership of over 300,000.

Its constituent societies are: American Society of Civil Engineers; American Institute of Mining, Metallurgical and Petroleum Engineers; American Society of Mechanical Engineers; American Water Works Association; American Institute of Electrical Engineers; American Society for Engineering Education; American Society of Heating, Refrigerating and Air-Conditioning Engineers; American Institute of Chemical Engineers; Society of American Military Engineers; American Institute of Industrial Engineers.

Its associate societies are: American Society of Agricultural Engineers; American Institute of Consulting Engineers; American Institute of Plant Engineers.

And its affiliate societies: Western Society of Engineers; Louisiana Engineering Society; North Carolina Society of Engineers; Engineering Societies of New England; South Carolina Society of Engineers; Los Angeles Council of Engineering Societies; Kentucky Society of Professional Engineers; Consulting Engineers Council.


FULL
FREE
DISCHARGE
NO SEAT
TO SCORE,
WEAR, CLOG
OR LEAK
DROP-TIGHT
SHUT-OFF

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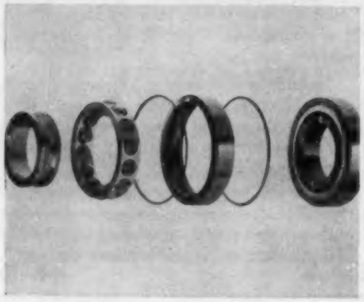
NEW EQUIPMENT



Heavy Duty Bearings

Load capacities from 19 to 55 per cent greater than equivalent size Conrad type bearings are obtainable by using the new high-precision Type HDR radial ball bearings now available from Split Ballbearing, Div. of MPB, Inc.

According to the firm, the bearing single-fracture design utilizes maximum ball complements. The new bearings have two to six more balls per bearing than equivalent size type bearings.

The manufacturing method consists of fracturing the outer ring of the bearing at one point, spreading it sufficiently to allow the assembly of a maximum complement of balls.

Full depth, symmetrical raceways with no loading slots permit the bearings to carry thrust loads from either direction, the company states. —K-1

Moisture Barrier for Aeropak

Aero Research Instrument Co. has developed a positive moisture barrier seal called AerOseal, that could breathe with the thermo cycling of ceramic insulated elements and maintains its moisture resistance.

The seal's effective temperature range is from −400 to +1000 F in continuous operation. It can withstand a thermal shock from +1000 to −300 F in two seconds. It will soon be available to users of AerOpak ceramic insulated thermocouple wire and heating elements. —K-2

Line Clamp

TA Mfg. Corp. announces a quick-action line clamp known as the TA5000 series that can be easily opened and closed indefinitely without distortion. It is completely self-contained.

The new Flip-Loc fastener is designed for electrical, hydraulic and pneumatic lines that have to be periodically removed for maintenance or access to adjacent equipment.

The unit has a rugged hinge built into the parent metal itself, which allows the clamp to be opened and closed without any binding or distorting.

An exclusive quick disconnect nut can be disengaged with one and one-quarter turn of a screwdriver on its integrated bolthead. The fastener can be opened and closed without removing clamp from its fixed mount. Other features, cited by the company, are self-alignment, temporary finger closure, all captive parts, high strength. —K-3

Dust Collector

A compact, low-cost industrial dust collector suitable for use in any light dust-producing operation is being produced by Torit Mfg. Co.

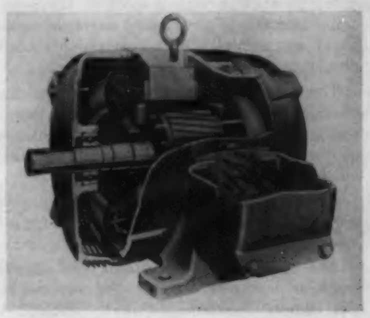
The new Model 301 stands $21^1/_2$ in. high and occupies a space 12 × 14 in. The new collector, the firm reports, is particularly suited to dust control in electronic and other precision production as well as to any light or occassional manufacturing operation producing dust.

The dust-collecting medium is a highly efficient, fire-resistant, throwaway glass filter. Performance ratings under standard test conditions are: 200 cfm; velocity, 4100; static pressure, 1.7 in w.g.; inlet, 3 in. The unit is equipped with a $^1/_4$ hp motor.—K-4

Harness Board Posts

John Hassall, Inc., announces carbon steel posts designed to be driven into the harness board as guides to permit rapid pre-assembly of wiring circuits for aircraft components, machine control panels, instrument circuits, switchboards.

The posts are made with rounded tops for easier wire placement and removal. Smooth nickel plated finish is designed to prevent any damage to insulation. The collar fixes the proper, uniform driving depth with or without the aid of pre-drilled holes, the firm reports. —K-5



Squirrel Cage Motors

A new line of squirrel cage Life-Line A motors from 3 to 75 hp is now available from the Westinghouse Electric Corp. These motors are designed for outdoor oil field pumping service.

Both the stator and rotor are designed to handle short time overloads. The temperature rating is 10 C below the maximum values of industry accepted standards, the firm reports. Full bar construction is used in the rotor to assure maximum rotor thermal capacity.

The company says high-slip, high-inertia design is employed to minimize the current peaks caused by cyclic loading, thereby reducing power peaks.

Other features of the new motors include baffling in both brackets for protection against rain and sleet; cast iron frame, and brackets and gasketed conduit box; silicone fortified thermosetting insulating varnish; fully protected bearing construction; and antirodent screens on all ventilation openings. —K-6

Pipe Insulation

Unarco U-200, a light-weight, rigid, urethane-foam pipe insulation, specially designed for use at temperatures ranging from −300 to +220 F has been announced by Union Asbestos & Rubber Co., Fibrous Products Div.

The firm says recent tests reveal that U-200 has a K factor of only 0.14 at 70 F, the lowest known for a commercially available product of its type. The material has a density of 2.3 lb per cu ft. It is not affected by most mastics and sealers normally used for cold insulation. The material is self-extinguishing, and has no capillarity. Humidity, water-absorption, and hygroscopicity are very low, the company reports. —K-7

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NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Auto-Collimator

The development of an electronic auto-collimator capable of measuring the tilt of a reflective surface with respect to the auto-collimator axis to the highest degree of sensitivity and accuracy ever achieved has been announced by Keuffel & Esser Co.

The new instrument is said to be ideal for checking flatness of surface plates, for monitoring drift of gyros, for checking straightness of machine tool ways, and for checking run-out of precision bearings.

According to the firm, the unit reads angles directly to a sensitivity approaching $^1/_{10}$ of a second.

The sensing unit transmits the signal (angular deviation) through the amplifier to the remote indicating unit by cable. A chart recorder can be used in addition to the indicator to provide a permanent record; or the signal can be fed into a servo mechanism or computer.

The components of the development include a sensing unit, a power amplifier, and an indicator. —K-8

Pneumatic Rivet Machine

A compact, pneumatic rivet machine, for heavy-duty applications, has been announced by Milford Rivet & Machine Co.

Said to be especially suited to multi-head or cluster installations, the Model 57 sets semi-tubular, full tubular or bifurcated rivets ranging from $^1/_8$ in. dia × $^1/_8$ in. long to $^3/_{16}$ in. dia × 1 in. long.

Several Model 57 heads may be grouped on a single base and combined with slide fixtures or transfer tables, as one production unit adaptable to automatic cycling. Actuated by pneumatically driven toggle linkage, operating on 60 to 150 psi shop air pressure, maximum cycling speed is governed only by the rate at which rivets feed into the jaws, the firm explains.

Stroke speed is readily adjustable to control impact when fragile materials, such as plastics or ceramics, are being assembled. The unit is connected directly to a shop air outlet when used individually on bench or pedestal mounts; when used in multiples, the heads are connected to a common manifold. —K-9

Silicone Fluids

Two new silicone fluids which exhibit unusual compatability with a diversity of materials have been introduced by General Electric's Silicone Products Dept.

Identified as XF-1030 and XF-1031, both fluids are claimed to offer a combination of properties not available in any other silicone. Like conventional silicone fluids, they are soluble in aromatic and chlorinated hydrocarbons. However, the firm points out, due to their unique composition, XF-1030 and -1031 are also soluble in many alipathic hydrocarbons and lower alcohols, including ethanol.

Another unique feature of these fluids is their ability to self-emulsify in water. Both instantly disperse in water with a minimum of stirring, forming a relatively stable emulsion.

The fluids have release and slip properties typical of all silicones. Properties shared by both include a specific gravity of 1.02–1.03 at 25C and a pour point of approximately −60C. —K-10

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Acceleration Switch

A new multi-level, unidirectional, single-axis switch, Model 200, capable of successively closing four independent electric circuits with a common point, in response to preset acceleration levels, has been announced by Instruments Div., W. L. Maxson Corp.

Each circuit remains closed for an acceleration level above its setting, resetting itself when the acceleration drops below the preset value. The firm says its small size and weight make it particularly suitable for use in aircraft and missile control, measuring, and indicating devices.

The unit consists of a gas damped seismic system with a range of 1 to 10g, an accuracy of $\pm$ .lg, repeatability of within .lg, a damping ratio of .8 of critical and temperature range of -60 to $+250$ F.

Switch is normally open single pole, four steps, with contact ratings of 100 ma each. The unit is hermetically sealed, weighs 20 oz and has dimensions of $3\frac{1}{4} \times 1\frac{1}{4}$ in. od. It meets the requirements of MIL-A-22145.

—K-11

Angle Control Valve

A new angle control valve with an improved venturi effect designed to reduce turbulence and cavitation in the control of slurries, viscous or flashing fluids has been developed by Minneapolis-Honeywell Regulator Co.

Pneumatically operated, the valve has both a bolted tailpiece, permitting easy access to the clamped-in seat ring, and a bolted bonnet which permits plug and stem replacement without removal of the body.

Applications of the valve are expected in petroleum refining, chemical manufacturing, paper-making, and in the utility industry for steam generation, and in the treatment of water, sewage, and industrial wastes.

A pneumatic diaphragm actuator provides air-to-open or air-to-close valve action. Valves are made of carbon steel and Type 316 stainless steel in sizes from 1 through 6 in. with body ratings to 600 lb. They are available with full capacity or 40 per cent capacity trim.

—K-12

Pneumatic Integrator

A simplified, pneumatic integrator for accurately weighing material passing over conveyor belts of its continuous weighers has been announced by B-I-F Industries, Inc.

The firm reports that the new integrator-totalizer automatically integrates (multiplies) belt travel with belt loading to produce direct readout of the true weight being conveyed over the weighing section of the company's Conveyoflo, a flow meter for bulk dry materials.

The integrator utilizes two components: a precise force-balance positioner and a disk-and-wheel integrator mechanism. The 7-digit totalizer is direct reading in pounds, tons, long tons, and does not need multipliers other than ciphers. Mounted in a dustproof, rubber gasketed steel case with cast aluminum door, the linear response integrator is highly sensitive, explosion-proof, uses less than 0.3 std cfm air consumption, and is adaptable for electric contactors for operating remote totalizers

—K-13

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BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

High Frequency Oscilloscope

A direct numerical reading oscilloscope, believed to be the greatest advancement since the initial development of these laboratory instruments, has been introduced by Allen B. Du Mont Laboratories, Inc.

Incorporating a unique digital readout system, the new high-frequency oscilloscope is said to become the first of its kind to be classed as an analog to digital converter. The firm says that as a result of direct reading, accuracy is increased because the possible errors in interpolating and converting mathematically have been eliminated. Valuable engineering time is saved by reducing time spent on interpolating waveforms, and the repeatability of accurate readings provides a new dimension in scientific measurement techniques.

According to the company, the use of the readout eliminates countless man-hours normally consumed in measuring, reading, and interpolating the standard visual signals from the face of the scope.

The direct numerical readout makes it possible for unskilled production workers to use oscilloscopes in production control processes, the company reports. After an original set-up by an engineer, the operator can read the amplitude and time measurements as actual digits on the scope panel. The scope can be tied directly into data processing or punch-card equipment for automatic recording and data analysis.

On the face of the instrument six thumb wheels and a joy stick positioner control are employed to traverse two display dots across the face of the cathode-ray screen. The two dots are moved in unison by the joy stick or index positioning control. When one dot, the indexing dot, is positioned on a reference part of the waveform, the two thumb wheel sets (horizontal and vertical) are then used to move the second (scaling) dot to the other position on the trace where the measurement is to be taken.

The thumb wheels, while moving the scaling dot, also control the digital display, and when the two dots are positioned, the exact time and amplitude are read directly in volts, seconds, milliseconds, or microseconds. The reading eliminates the need for any dial multiplication, interpolation and parallax adjustment, and is reputed to be far more accurate than any human measurement because the possibility of error is eliminated.

Known as the Du Mont Model 425, high-frequency oscilloscope, the new instrument also incorporates two, 40-pin connector plugs coded in a ten-line arrangement for each digit thus providing possibilities for printing remotely on accessory equipment or relaying the information to a computer via punched cards or tape. An analog voltage proportional to the digital readings is also available and may be introduced directly into an analog computer or pen writing recorder for further application. —K-14

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BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS

Special Pumps

Moyno Pump Div., Robbins & Myers, Inc. has introduced a new line of small, special application pumps for product application.

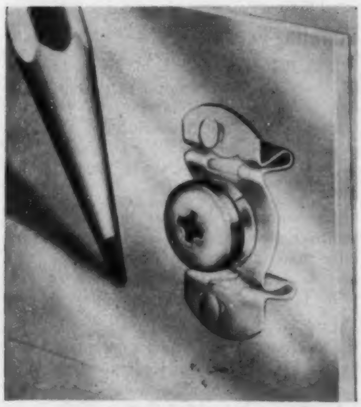
The firm reports that the units have no pistons, valves or high-speed impellers. The only moving part is a stainless steel helical screw rotor which turns within a fixed rubber stator having a double internal helical thread.

The company explains that the resulting pumping action is somewhat like that of a precision screw conveyor; cavities formed between the rotor and the stator move toward the discharge end of the pump, carrying the material being handled.

This principle provides positive displacement, low internal turbulence and continuous, uniform flow suitable for metering purposes, the firm says. It also enables the unit to handle a broad range of materials, from water-like liquids to heavy, abrasive slurries and substances containing relatively large particles in suspension.

Designed for production in quantities as small as 100, the pumps are available in 24 cataloged models with deliveries ranging from metering flow to 1200 gph. Discharge heads range to 300 psi. They are available either with or without direct connected motors.

—K-15



New 1/4-Turn Fasteners

Minature Lion Fasteners now being produced by Southco Div., South Chester Corp., are designed to provide smaller dimensions to save weight and space.

The receptacle measures .812 by .375 in. overall and has a thickness of .012 in. The retainer and stud are correspondingly proportioned. Six different stud lengths accommodate total material thickness (both sheets) of .040 in. minimum to .159 in. maximum. The three parts are made of cadmium-plated steel.

They require one-quarter turn to open, one-quarter turn to close, the firm reports.

—K-16

KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Angle Valve

A new angle valve which doubles for both liquid level gaging and instrument piping and general use is announced by Jerguson Gage & Valve Co.

The new No. 74 valve combines features designed to prevent freezing and eliminate problems of wear from galling in one valve unit built with a minimum of parts.

According to the company, the unit serves as a basic liquid level gage valve; with the addition of a special pipe plug with integral bleed fitting it becomes instrument valve No. 74G which eliminates multiple connections in instrument and general use.

The valve combines in one valve the advantages of a single-piece forged valve body and bonnet flange to which is mounted a simplified outside screw and yoke bolted bonnet and a new design reciprocating-backseating stem.

The bolted bonnet uses a forged yoke which supports the stem away from the valve body and a separate forged gland-follower which bears directly on the packing and is entirely independent of the yoke. This construction places the threaded portion of the stem outside of the valve body where it is not affected by temperature or the nature of the liquid being handled. **—K-17**

Vibrating Feeders

Link-Belt has announced the addition of 49 new sizes, in two motor capacities, to its line of motorized counterweight vibrating feeders. With the new additions the company now offers more than 60 sizes of MC feeders with capacities up to 1700 tons per hour.

The company describes the machines as compact, low headroom devices for feeding bulk materials ranging from heavy, sticky ores to light, dry grains at a uniform rate from bins, hoppers, storage piles or conveyors.

The company has added a completely new line of MC twin motor feeders that includes 31 sizes with capacities from 275 to 1700 tph. It also has added 18 new single motor feeders to its existing line with capacities from 5 to 525 tph. Size ranges now include feeder lengths from 4 to 14 ft, trough widths from 1 to 6 ft, and capacities from 5 to 1700 tph.

The feeders consist of a trough and either a single or double motorized vibrator drive, mounted directly to the channel frame. The vibrator is driven by motors especially designed for vibratory service, with a double-extended shaft on which counterweights are mounted.

An unbalanced arrangement of weights imparts a straightline oscillating or vibrating motion to the trough, lifting the material upward and forward along the trough length. **—K-18**

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BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS

Secondary Time Standard

Zenith Radio Corp. has announced the world's first portable, self-powered secondary time standard.

According to the company, the instrument provides a portable time source accurate to approximately ±16 sec per year, and can be used for precisely timed, on-off control of recording instruments, telemetering transmitters, etc., located in remote or isolated areas.

The firm said the device is completely transistorized, measures 7 × 11 × 7 in. in a handle-equipped case, and weighs 9 lb complete with batteries.

The unit's transistor radio is a crystal controlled amplitude modulated receiver utilizing single conversion and 455 kc if. It is engineered to receive WWV, the National Bureau of Standards station, Beltsville, Maryland, and other accurate sources of "seconds tick," the firm said, at any of three switch-selected frequencies: 2, 5, 5.0, and 10 mc.

Output of the receiver is fed to a decoder in its circuitry that filters out all information except the one second "tick." This, the firm states, is applied to a pulse generator which generates a pulse of the required amplitude and duration to synchronize the dc operated clock.

The decoder, the firm said, contains special circuits which will prevent false signals from disturbing the clock. **—K-19**

Venturi Burners

A complete line of inshot and upshot venturi burners, for OEM application, is now being manufactured by Barber Mfg. Co.

Burners are of all-steel construction, stamped and welded for light weight and flexibility for installation in furnaces, boilers and hot water heaters. Models provide varying venturi lengths; different spreader heights; various flame spreader shapes; and Btu inputs ranging from 5000 to 400,000 Btu depending on the specific application. **—K-20**

KEEP INFORMED — BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS

Dual-Range Manometer

F. W. Dwyer Mfg. Co. has introduced a new low cost dual range manometer that can be used either as a vertical U-tube manometer or as an inclined manometer in the measurement of low pressures.

A special scale allows reading high range measurements on the other leg when gage is inclined. This new No. 1226 is claimed to be the only one of its kind with this unique convenience feature.

When used as a U-tube manometer, pressures or pressure differentials are measured from 0 to 16 in. of water with minor scale divisions of .2 in. water. As an inclined gage the manometer reads from .20 in. to 0 to 2.60 in. of water with minor scale divisions of .02 in. A simple, foolproof method of setting the manometer to zero on the inclined scale, eliminates the need for a spirit level to determine the correct angle of inclination, the firm reports. **—K-21**

Inertial Platform

Giannini Controls Corp. announces the development of a new simplified self-contained inertial platform system for short range ballistic missiles.

This non-servoed system is designed to fill the requirement for a really small ($2^3/_4$ in dia $\times$ $4^1/_2$ in. long), low cost guidance package that will eliminate misalignment and dispersion problems during the high acceleration boost stage of flight.

System components consist of a free gyro and two subminiature accelerometers. The accelerometers are mounted on the gimbals of the gyro with the sensitive axes oriented perpendicular to the gyro spin axis. The gyro spin axis then describes the line space along which the rocket is guided. The system is claimed to be highly accurate and fully operative within 5 sec after power is applied. **—K-22**

KEEP INFORMED

BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS

Inorganic Board

A new, inorganic insulating sheet material that combines light-weight and structural strength, has been announced by Union Asbestos & Rubber Co., Fibrous Products Div.

It is called Unarcoboard. The firm says the 100 per cent incombustible board can be used for ovens, ceilings, partitions, back-up-board for pre-laid tile or brick facing, duct work, firewalls, fireproofing structural steel, heat screens, housings and breechings, and high temperature test chambers.

Available in sheets up to 4 × 8 ft in size the white board can be worked like wood without damage to woodworking tools, and takes and holds nails and screws like lumber. The firm reports that for precision model making applications, it can be planed to .001 accuracy. **—K-23**

Laboratory Recorder

Sippican Corp. has announced a general purpose laboratory recorder for use with up to six resistance-type sensing elements or transducers.

Six self-contained temperature controlled bridge circuits are designed for sensor resistances of 85-350 ohms. The unit records output of the sensors every 5 to 30 sec. According to the firm, the full scale range is continuously variable from 0.6 to 60 ohms with an accuracy of $\pm$ 1/2 per cent full scale reading. Modifications permit use with up to 18 sensors and wide variation of the sensor resistance range.

In typical applications, using chemically pure nickel sensors, temperature changes of .01 F in range of 100 to 160 F are continuously monitored and recorded, the firm reports the unit is also available for 19 in. relay rack mounting. **—K-24**

Dry-Off Ovens

A range of 24 standardized, monorail, conveyorized dry-off ovens and patch-type drying units have been designed by Ramco Equipment Corp.

In the new pre-engineered ovens, both the blower and heating units are located in the bottom of the oven for compactness. High pressure steam and gas-fired heaters, protected by safeguard controls (FM), are available in all models.

Ovens are constructed of interlocking panels, with 2 in. of glass wool insulation between the inner and outer 20-gage steel panels. Mechanical heat seals confine the heated air in the oven, where it is recirculated at a high velocity by heavy duty centrifugal fans through slots surrounding the exit and entrance. Free draining parts can be dried in under three minutes, the firm says. **—K-25**

KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Sensitized Papers

A new semi-moist diazo sensitized paper line is now available from the Ozalid Div., General Aniline and Film Corp.

The new line, marketed under the trade name Ozalid Reprofax, will include a 17 lb lightweight white paper with five printing speeds; a standard $20^1/_2$ lb white paper with five speeds; beater-dyed 17 and $20^1/_2$ lb papers in six base colors; a medium weight 24 lb white paper, single and double coated; 48 lb white card stock; and new transparentized sepia intermediate papers.
—K-26

Pipe Joint Sealer

A snap action, cutting dispenser for Thred-Tape pipe joint sealer has been introduced by Crane Packing Co.

The dispenser incorporates a cutting assembly made of chrome plated steel with a tempered and ground edge which is clamped on a clear plastic container. According to the company, it provides dirtproof means for handling the tape and constantly shows the amount available.

The dispenser is designed to accommodate the tape in the $^1/_2$ in. size and has sufficient capacity to hold either a 288 or 567 in. roll. It is reusable and easily opened to insert a new roll.

The firm explains that Thred-Tape is the new thread sealer that seals connections under the most difficult service conditions, including practically all corrosive chemicals, caustics, hydraulic, and aromatic fuels, also toxics, biologicals, and gases. —K-27

Bronze Valve

Walworth Co. announces the development and manufacture of a solder joint, rising stem, bronze gate valve.

The new valves are available in sizes $^3/_8$ through 3-in., inclusively, and have a pressure rating of 125 lb.

The union bonnet, it has been proven, will eliminate distortion caused by mechanical strain or temperature changes. With the exception of the body of these new valves, which have been designated No. 2SJ, all of the parts are interchangeable with those of screwed-end, 125-lb, rising-stem, gate valve of the same size. —K-28

KEEP INFORMED

BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS

Drum Foot Valve

Universal Valve Co. announces its No. 409 foot valve, designed specifically for use inside 55 gallon standard drums containing liquids for concrete additives.

Initially the valve body was made in cast iron, the poppet assembly in steel with a Buna N disk and a threaded cast iron adaptor. The complete assembly may be made in special materials to suit the liquid to be used.

According to the firm the valve has slim design characteristics of the body which permit a wide range of adaptor sizes ($^1/_8$ to $1^1/_4$ in.) to be mated with the body and still fit through the bung opening of a standard 55 gal drum. **—K-29**

Plastic Potentiometers

New England Instrument Co. announces that conductive plastic potentiometers Models 78P ($^7/_8$ in. od) and 156P ($1^5/_{16}$ in. od) are now available in multigang units to a maximum of six gangs per assembly.

The firm says these are infinite resolution, long-life, low noise units and can be had in servo or bushing mounts. They have a life expectancy of 50,000,000 revolutions.

Standard units are available in 100 ohm to 10 megohm resistance value. Standard linearity is 0.5 per cent closer, linearities can be supplied on special order. **—K-30**

New Teflon Resin

Du Pont is commercially producing a new plastic Teflon 100.

Known as an FEP-fluorocarbon resin, the new material can be extruded or molded in thermoplastic processing equipment. The company's material is virtually immune to chemical attack, has excellent electrical insulating, anti-stick, and frictional characteristics, and will not absorb moisture. Teflon 100 differs somewhat from the TFE resins in heat resistance. TFE resins are rated for continuous service at temperatures up to 500 F and at higher temperatures for more limited periods of time. The usual continuous service ceiling for Teflon 100 FEP resin is about 100 F lower. Both materials resist extreme cold—down to −450 F. **—K-31**

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BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS

Integrating Gyro

Kearfott Co., Inc., a subsidiary of General Precision Equipment Corp., announces the addition of the M2514-02 unit to its line of miniature floated rate integrating gyros.

This component is designed to be mounted directly on the frame of missiles or aircraft and provides a linearity of 0.02 per cent and a large angular momentum of 250,000 gm cm^2/sec. The firm says these features, together with an unusually large angular input capability, enable the unit to be used in place of a stable platform in certain systems. **—K-32**

Silicon Rectifier

Syntron Co. announces the addition of the Style 31, double diffused silicon rectifier to its expanding line of power rectifiers.

The unit is rated at 17 amp average at 25 C ambient on a $5 \times 5 \times {}^1/_{16}$ in. copper heat sink. Peak inverse voltages range from 50 to 400 v, in 50 v steps.

A typical forward dynamic resistance of .009 ohm is achieved by diffused junction techniques, the firm reports. **—K-33**

Control Valve

A unique, new miniature four-way directional control valve with a sliding spool construction has been announced by Sarasota Precision Products, Inc.

Designed especially for use in small hydraulic circuits, under 3 gpm, this new valve is $2 \times 1^1/_2 \times 5$ in. (plus handle) and weighs 1 lb 2 oz.

The firm says the valve has a low pressure drop of approximately 13 psi at a rated capacity of 3 gpm. Its low internal leakage is less than 10 cu in. per min at 2000 psi with 150 ssu oil.

The balanced spool is of hard-coated aluminum. The valve is available with standard $^1/_8$ and $^1/_4$ in. dry seal pipe threads. Special porting or manifold mounting can be made to order. **—K-34**

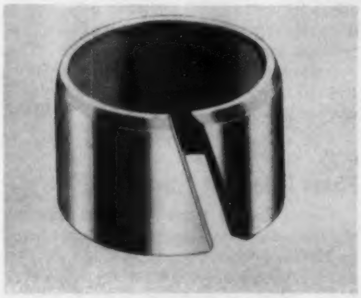
Air-Loaded Pilots

Control accuracy to within $^1/_8$ psi or better from positive pressures through the vacuum range to 30 in. Hg is made possible by a versatile new series of air-adjusted pressure pilots developed by Spence Engineering Co.

The firm says the pressure pilots can also be used in conjunction with a temperature recorder-controller for control of process temperatures.

Extreme sensitivity of control for low pressure systems or for vacuum heating systems is obtained by the new vacuum-range pilots, the company states. The pilots are also suitable for the greater vacuums common to many low temperature heating processes.

—K-35



Spring Tension Bushes

John Gillen Co., has introduced a new line of tension bushes for oscillating or low rpm bearing applications.

The bushes are tubular hardened spring steel, with straight slot, slanted slot, and arrow slot where center lubrication is required.

The bushes have machined chamfered ends for quick insertion, the company reports. They are held in position by spring tension. They are available in various sizes, for railway, farm implement, construction, and heavy machinery equipment applications.

—K-36

Limiting Device

A new limiting device, engineered to provide positive protection against motor overload and featuring an adjustable demand limiter, has been released by the Johnson Service Co.

Called the R-27 load limiting relay, the device, which is designed for use with pneumatic control systems, is intended for application to all types of centrifugal refrigeration compressors. Installed in the pneumatic control circuit and responding to motor current, it limits the opening of the capacity

KEEP INFORMED

BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS

regulating inlet valves or dampers to maintain a predetermined maximum motor current regardless of the demands of other controllers.

According to the manufacturer, the unit is especially valuable in preventing damage during the start-up period and following prolonged or over night shutdowns.

The relay has a remotely located manual adjuster for limiting the motor current to any selected value between 40 per cent and a 100 per cent of the maximum. Designed to operate at any current between 3-7 amp, when used with a properly selected current transformer it can be applied to motors of any size, the firm reports. The secondary winding of the current transformer energizes the coil of the unit relay which in turn activates a conventional pneumatic relay to vary the output pressure in inverse proportion to the current. Maximum motor current is established by an integral set point adjustment. A supplementary winding on the relay coil, provides the demand limiting feature. This potentiometer, with a dial graduated from 40 to 100 per cent, may be located at any convenient location. —K-37

Flame Retardant Trays

A new line of flame retardant Kennett materials handling receptacles is announced by National Vulcanized Fibre Co. for plants where exposure to fire is a potential hazard or where safety programs require the use of flame resistant materials.

The new units are made of Pyronil, a flame retardant grade of vulcanized fibre,described as a hard, smooth, cellulose plastic material specially treated to prevent the material from supporting combustion.

The new receptacles are available as trays, pans, bins, boxes, floor trucks, baskets, and containers. —K-38

Variable Vane Pump

A new 6 gpm delivery unit has been added to the line of vane type variable volume hydraulic pumps produced by Vickers Inc., Div. of Sperry Rand Corp. The firm says that while specifically designed for low cost machine tool drill feed and automation applications, the new unit can be used in circuits that require pump delivery to vary according to system needs while maintaining preselected adjustable pressure.

The new pump includes an integral pressure compensator that can be set for from 200 to 500 psi operation. Maximum delivery can be limited by means of a mechanical adjustment. The company reports that sharp cut-off characteristics enable the pump to deliver nearly full volume up the compensator setting even at low operating pressures. —K-39

Continued on Page 159

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8, 9	28	38, 39	147	159	170T	185TR	
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K-1	K-12	K-23	K-34	K-45	K-56	K-67	K-78	K-89	K-100
K-2	K-13	K-24	K-35	K-46	K-57	K-68	K-79	K-90	K-101
K-3	K-14	K-25	K-36	K-47	K-58	K-69	K-80	K-91	K-102
K-4	K-15	K-26	K-37	K-48	K-59	K-70	K-81	K-92	K-103
K-5	K-16	K-27	K-38	K-49	K-60	K-71	K-82	K-93	K-104
K-6	K-17	K-28	K-39	K-50	K-61	K-72	K-83	K-94	
K-7	K-18	K-29	K-40	K-51	K-62	K-73	K-84	K-95	
K-8	K-19	K-30	K-41	K-52	K-63	K-74	K-85	K-96	
K-9	K-20	K-31	K-42	K-53	K-64	K-75	K-86	K-97	
K-10	K-21	K-32	K-43	K-54	K-65	K-76	K-87	K-98	
K-11	K-22	K-33	K-44	K-55	K-66	K-77	K-88	K-99	

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BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS

Urethane Foaming Resin

A new liquid urethane resin prepolymer formulated with a halogenated hydrocarbon is being marketed by Thiokol Chemical Corp.

Designated Rigithane 334 foaming resin, the new product is designed for use in the production of rigid foams with high-strength to weight ratios and low thermal conductivity properties. The halogenated hydrocarbon is either incorporated in the prepolymer package or added at the point of application, according to customer preference. —K–40

Molded Nylon Screws

Three new sizes of precision molded nylon screws have been announced by Gries Reproducer Corp.

The new sizes can be ordered from stock in No. 0–80, No. 1–72 and a special No. 4–90 thread sizes. The firm says the "watchmaker size" machine screws are intended to be produced in a complete range of lengths and head types. They make available a full line of nylon fasteners in sizes from No. 0–80 up to and including 5/16–24. —K–41

BUSINESS NOTES

Become Divisions

Eaton Mfg. Co. has announced that its wholly owned subsidiary, Cleveland Worm & Gear Co., and the latter's subsidiary, Farval Corp., have become divisions of Eaton under their present respective names.

Cleveland Worm & Gear, a manufacturer of industrial worm gears and worm gear speed reducers, and Farval, producer of centralized lubricating systems, were acquired by Eaton on January 31, 1959, and since then have been operated as subsidiaries.

Fuel Cell Research

Pratt & Whitney Aircraft will widen its power activities outside the aircraft engine field by expanding work on developing and manufacturing highly efficient fuel cells.

Leesona Corp., formerly Universal Winding Co., and Pratt & Whitney Aircraft, Div. of United Aircraft Corp., have announced an enlarged joint research and development program covering the entire field of the fuel cell. The previous cooperative program of the two companies, on the hydrox fuel cell, was announced last fall.

KEEP INFORMED

BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS

New Research Lab

A new 8000 sq-ft research and quality control laboratory has been opened at Latrobe, Pa. by the spring and forge div. of ALCO Products, Inc.

The laboratory, representing a total investment of more than $300,000, is housed in a new, one-story brick building. It is completely air-conditioned, and has complete testing and development equipment. The firm's former facilities for research and quality control were destroyed in a fire last year.

LATEST CATALOGS

Variable Speed Pulleys

A full line of variable speed pulleys—plus related equipment including compound drives, motor bases and frames, wide V-belts and sheaves– is described in a 24-page illustrated technical catalog issued by Hi-Lo Mfg. Co.

Information includes selection and operating data, horsepower, ratings, dimensions, and representative applications for the wide variety of sizes and models. The pulleys are the cam-operated type which positively maintain desired speed even under overload conditions. They range from fractional to 5 hp with speed ratios from 1.75-1 to 2.6-1.
—K-42

Fastener Tools

A four-page illustrated two-color bulletin, Form 8-475, describing its Model 285 and Model 287 Pneu-Hydra fastener installation tools is now available from Huck Mfg. Co.

The bulletin illustrates the new pneumatic-hydraulic tools and describes their operating characteristics. Performance curves show pulling capacity related to input air pressure for each tool. Outline drawings indicating significant external dimensions are also included.
—K-43

Speed-Draw Presses

A catalog, No. 2029-A, covers a new line of speed-draw presses recently announced by Steelweld Machinery Div., Cleveland Crane & Engineering Co.

Diagrams depict the unusual patented mechanism which provides an operating speed that is said to be 80 per cent over that of standard mechanical presses. The presses are designed for deep-draw work and often make it possible to reduce the number of operations required to form a part, the company states.
—K-44

KEEP INFORMED

BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS

General Plate Products

A revised brochure, General Plate Products, 3rd edition, 10 pages, describes the scope of Texas Instrument, Inc., Metals and Controls Div. solid and clad base metals, solid and clad precious metals, thermostat metals, electrical contacts.

Included is data on the company's "industrial" metals: profile rolled strip, manganese age-hardening alloys, copper-cored glass sealing alloy wires, solid and clad reactor metals, clad metals for semiconductor applications and aluminum-iron alloys. **—K–45**

Rachet Wrenches

A simplified method for figuring correct wrench size for any bolt or nut diameter is included in Lowell Wrench Co.'s new catalog.

Shown is the firm's complete line of reversible ratchet wrenches, including its new $^1/_8$ in. square drive socket sets, available in 10-point and conventional 12-point sizes. Specifications and details are given for Warnock strap wrenches and Swaco railroad car movers and hopper car wrenches. Reversible ratchet wrenches for special applications are also described. **—K–46**

Research Facilities

A 24-page, two-color brochure covering modern research and developent facilities for engineers and scientists which have been designed, built and equipped by H. K. Ferguson Co. has been published by the firm.

The booklet describes and pictures laboratories and development complexes in the fields of basic research, nuclear research, aeronautical and missile research, special research and depicts modern auxiliary features incorporated by the architect-engineer-builder. **—K–47**

Work-Holding Tools

A catalog No. 27, featuring the Palmgren line of work holding tools has been published by Chicago Tool & Engineering Co., illustrated and described are drill press vises, angle vises, swivel machine vises, adjustable angle plates, rotary tables, milling tables, tilting tables, lathe milling attachments. **—K–48**

Motor Graders

An eight-page booklet by Caterpillar Tractor Co., describes the main features of the company's three motor graders.

The 150-hp Cat. No. 14 is cited for its turbocharger, high clearance moldboard, dry-type air cleaner, oil clutch, and other features The No 12, with 115 hp, is detailed as "a favorite for two decades" Low investment for high utility and economy is emphasized for the 75-hp No. 112.**—K–49**

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Spacing Products

Three new catalog inserts describing the De-Sta-Co spacing products line are now available from Detroit Stamping Co.

The inserts describe heavy, machined collars, feeler stock in coils and strips, brass and steel shim stock and arbor spacers and shims. New close tolerance die shoulder screw adjustment shims for lengthening or shortening die stripper plate travel are included. **—K-50**

Four-Slide Machine

Operating features and specifications for its new V-81 Verti-Slide vertical four-slide machine are given in a six-page technical bulletin published by Torrington Mfg. Co.

Machine components described include the unique cam timing disk, center form, slide feed assembly, toggle-type press and forming slides. Specifications cover machine capacity, drives, slide strokes, press, feed (90 and 180 deg). **—K-51**

Plate Magnets

Stearns Magnetic Products has issued a bulletin describing its new Indox V plate magnet models.

The bulletin gives selection data for magnets for existing chutes, ducts, conveyors, or other material handling equipment. Tables show recommended magnet size according to conveyor size, speed of material flow, size or mesh of material. **—K-52**

Gas Injection Project

Bulletin 183, published by Clark Bros. Co., one of the Dresser Industries, presents a report on Arabian American Oil Co.'s new gas injection project in Ain Dar, Saudi Arabia.

The article describes this $30,000,000 project which will gather and inject 210,000,000 cu ft of gas per day in the Ghawar field. Details of the operation are covered including the use of five series connected gas turbines for compressor drive, plus the use of an additional turbine to drive a 5600 kw generator to power the gas-oil separator plants. **—K-53**

Hot Water Plant

J. O. Ross Engineering Div., Midland-Ross Corp., offers a four-page technical article which tells how the Personal Products Corp. modified its high-pressure hot-water generating plant to enable it to produce both steam and high-pressure hot water, and to improve the parallel operation of its boilers.

The article gives information on alterations to present equipment, equipment additions, and changes in piping systems. It contains a schematic drawing diagramming the new system and includes five photographs showing the boilers, hot water generator, circulating pumps. **—K-54**

Airborne Power Supply

A four-page brochure from Neff Instrument Corp. describes specifications, operational characteristics, and design features of a new line of airborne strain-gage power supplies.

These instruments provide 1 or 3 amp at 5, 10, or 15 v output, with 0.1 per cent stability and operation from −55 to +85 C. Graphs illustrate load regulation, temperature stability, and line regulation. **—K-55**

Bin-Gate Flow Control

Syntron Co. announces publication of a new catalog sheet on its iris-type flow control valves which provide control (and positive shutoff) of bulk materials from bins and chutes and for regulating eddy-free air in heating and ventilating.

Principal feature of the valve is a flexible diaphragm which opens and closes through continuously variable concentric apertures. This resilient diaphragm surface is designed to resist jamming. **—K-56**

Magnetic Brakes

A bulletin on d-c magnetic brakes has been published by Electric Controller & Mfg. Co., Div. of Square D Co.

The new bulletin explains in detail the construction features of Type WB brakes which are available in six sizes to cover the complete range of 600-series motors. The bulletin also illustrates maintenance procedures, and contains selection charts for matching brakes to specific motors. **—K-57**

KEEP INFORMED

BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS

Air-Cooled Compressors

A 16-page bulletin describing and illustrating Unitair compressors has been released by Joy Mfg. Co.

Included are specifications on eight sizes of the air-cooled compressors in the 15 to 125 hp 81 to 641 cfm range. Cross section drawings and a run-down on all vital components are included. **—K-58**

Heat Treating

A study of temperature uniformity in heat treating is the subject of an eight-page reprint available from Ipsen Industries, Inc.

The author discusses temperature uniformity and furnace design. Described is a series of tests conducted to measure temperature variations within the heating zone when a charge is placed in the furnace and brought up to heat. The series of tests were run at 1550 F, and repeated at 1850 F. **—K-59**

Feed Water Treatment

Western Chemical Co. announces availability of a bulletin which discusses the need for boiler feed water treatment and shows how it can be done.

The four-page folder illustrates and describes methods for scale prevention, corrosion control, suppression of foaming, and carry-over and sludge dispersion. **—K-60**

High Temperature Tubing

Small tubing made from A-286, an alloy developed for high-temperature applications, is described in a special analysis memo, No. 114, published by Superior Tube Co.

Advantages of the tubing described include high strength and scaling resistance at temperatures up to 1300 F and low strategic-alloy content. An austenitic iron-nickel-chromium alloy, it can be precipitation hardened to develop its strength properties. The memo lists the chemical composition and physical properties and the standard production limits for both seamless and welded and drawn tubing. **—K-61**

Plate Heat Exchanger

A 12-page brochure describing its line of plate heat exchangers has been issued by the De Laval Separator Co.

The brochure includes photographs and specifications of plate heat exchangers for use in laboratories and small plants, medium size plants and high capacity plants. A special feature of the brochure is a four-page, four-color fold-out that diagrams the flow of the firm's HTST pasteurizer. Other features include photographs of installations. **—K-62**

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Voltage Regulators

Twenty-three JFR distribution voltage regulator features designed to provide more economical and better voltage regulation are described and portrayed in a bulletin released by Allis-Chalmers.

The new regulator's smaller size—up to 33 per cent in height and weight—is designed for great versatility in pole, platform and sub-station mounting. When pole mounted, the control compartment can be remotely located to permit electrical adjustment of the regulator's position indicator drag hands from the ground. —K-63

Toggle Switches, Assemblies

Micro Switch Div., Minneapolis-Honeywell Reg. Co., announces a catalog on high-performance toggle switches and toggle switch assemblies for use in airborne, mobile, marine, electronic, and commercial applications.

Catalog 73d includes a selection of military versions that have been tested and approved under MIL-S-3950A, as well as pull-to-unlock hermetically sealed, electrical memory, rocker-actuated, and miniaturized designs. —K-64

Nuclear Controls

A 12-page catalog on mechanical remote control systems for the nuclear industry is available for Teleflex, Inc.

The catalog describes and illustrates typical control systems developed for nuclear installations. Photographs and drawings show how the systems allow remote positioning of elements (such as fission chambers, neutron sources, samples, and thermocouples) and how they are used for remote mechanical control in reactor cores, hot cells or in any inaccessible location. —K-65

Standard Power Tools

A new book on industry's approach to low-cost tooling with standard industrial power tools, is available from Delta Power Tool Div., Rockwell Mfg. Co.

It contains 65 illustrated case histories showing how the tools are used in combination with other tools, with automatic controls and in special setups to combine operations, to automate operation, to increase production, to improve quality and to perform operations conventionally performed on more expensive, special purpose machines. Cases cover tooling problems ranging from turning cold rolled steel to producing close-tolerance missile components. —K-66

Wafer Capacitors

Four-page data sheets on glass-dielectric wafer capacitors are available from the Electronic Components Dept., Corning Glass Works.

They describe the capacitors as ideally suited for printed circuit, modular or encapsulated assemblies requiring high reliability. The items are said to be the smallest high stability capacitors currently available.

The capacitors are flat. Thus, the firm says, types without leads can be flat or slot mounted. Because dielectric and conductor layers are sealed together at high temperatures and pressure, they will operate under high heat and humidity environments without further encasing. —K-67

Split Case Pumps

Product descriptions, dimensions, application data, and performance characteristics of an augmented line of building trades pumps are included in a 12-page bulletin available from Peerless Pump Div., Food Machinery and Chemical Corp.

According to the manufacturer, these split case building trades pumps, sold under the trade name "AquaLine," are available in both packed and sealed types, in sizes from $1^1/_2$ through 4 in. discharge, and the packed type is available through 8 in. discharge. —K-68

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Industrial Paint

The gain in visibility of Day-Glo Fluroescent safety paint over conventional safety colors is illustrated in a brochure offered by Switzer Brothers, Inc.

Through the use of a diagonal flap, the interior of a typical industrial plant is bisected to show the paint, printed in Day-Glo ink, in comparison to normal safety color on crane hooks, a fork lift truck, critical switches, fire extinguisher, railings, signs, and other articles. The back page of the brochure illustrates nine detailed applications of the paint to hazards and safety equipment. **—K-69**

Screw Thread Form

The Hi-Life thread—a recent advance in industrial fasteners—is the subject of a four-page folder offered by Standard Pressed Steel Co.

Through the use of photoelastic studies the new literature depicts the change from the old flat-root thread form to the fastener's controlled thread root form which features a larger and more uniform root radius of concave configuration. Originally developed for ultra high-strength fasteners, the improved root radius is claimed to add greater cross-sectional area, effectively distributes stresses and substantially increases fatigue life. **—K-70**

Surface Measurement

A pocket-size 12-page, surface measurement reference manual containing excerpts from the American Standard ASA B46.1-1955 for surface roughness, waviness, and lay is available from Brush Instruments Div., Clevite Corp.

The manual covers classification of surface characteristics, stylus-type measuring instruments, precision reference specimens, roughness width cutoff and notes on control of surface roughness. A conversion chart is provided for converting arithmetical average to root mean square averages in microinches. The Surfindicator, a production gage for finish control is also described and illustrated. **—K-71**

Motor Controls

Furnas Electric Co. has published a 72-page motor control catalog, 5900, that provides a condensed but thorough listing of general products, some of which are new within the last year.

Special selector charts for magnetic and manual starters give horsepower, motor speed, heater size, heater ampere ratings, enclosure choices, along with style numbers and list prices. The new catalog contains descriptive copy, design data, stocking information and ordering instructions for manual starters, magnetic controls, drum controllers, pressure switches, various pilot devices. **—K-72**

Power Equipment

Engineering specifications and application descriptions of electrical components for missile and aircraft ground power equipment are contained in General Electric Co's. new Bulletin GEA-6973.

The 12-page bulletin covers electrical generating components at either 60- or 400-cycles for such applications as military aircraft ground power, commercial aircraft ground power, computer power supply, missile ground power and special military projects. **—K-73**

Air-Cooled Condensers

Halstead & Mitchell has issued a catalog on air-cooled condensers that present an analysis of these devices from the standpoints of specification and application.

Four types of units are discussed: those using propeller fans for horizontal air flow, propeller fans for vertical air flow, centrifugal fans for use with duct-work, and centrifugal fans for residential air-conditioning. **—K-74**

Vibrating Coolers, Dryers

Catalog 953, a 32-page book, covering electric and mechanical vibrating type coolers and dryers of both the direct and indirect type, is available from Jeffrey Mfg. Co.

Included are sections on basic drying principles and the TMV variable amplitude unit. Pages are also devoted to such auxiliary equipment in the vibrating line as feeders, conveyors, magnetic separators, packers, controls, and the Waytrol constant weight feeder. A pilot unit rental system is outlined. **—K-75**

Fluid Drives

An illustrated bulletin, No. A519, describing the application of Gyrol fluid drives to pipeline pumping stations for pipeline flow control is available from American-Standard Industrial Div.

The bulletin outlines the advantages of the adjustable speed units in flow control applications and cites the firm's background of pump installation experience. Operating principles are explained and illustrated with schematic section drawing of a typical adjustable speed fluid drive. **—K-76**

Cams, Camshafts

Meehanite Metal Corp. has available a 12-page booklet covering Meehanite cams, camshafts, and crankshafts.

It describes briefly the basic metallurgy and important engineering properties of a few types of Meehanite metal most widely used for such service. **—K-77**

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Pumps, Controls

A 72-page catalog, Bulletin No. 220, giving design details and operating characteristics on the company's complete line of hydraulic pumps, fluid motors and valves has been published by Denison Engineering Div., American Brake Shoe Co.

Special sections in the publication are devoted to each of the following: hydraulic pumps, axial piston type; hydraulic pumps, vane type; pumping units; fluid motors; axial piston type; fluid motors, vane type; four-way directional control valves; check valves; electro-hydraulic pressure control valves; and pilot operated pressure control valves; surge damping valves; and flow control valves. —K–78

Gasket Selection

A card, designed to facilitate selection of the various gages of Color-Plast shim and gasket material by color identification, has been announced by General Gasket Inc.

According to the firm the versatile shim and gasket material, is completely impervious to oils and greases, even when boiling hot. It will not swell or become distorted after long use, and it will withstand high torque loads, the company reports. —K–79

Power Plants

An eight-page booklet announcing the new Kohler Trio, a series of diesel engine powered electric plants, has beeen published by Kohler Co.

The new 2000, 5000, and 7500 w diesel electric plants were engineered for the construction, marine, railroad, and industrial markets. Fuel economy and quick, cold weather starting are claimed for the engine's direct injection combustion system. —K–80

Water Treatment Control

Methods for automatic control of water treatment plants are discussed in Technical Reprint T-179, available from Graver Water Conditioning Co.

Part I deals with control of demineralization plants and covers such subjects as stepless regeneration, quality control of effluent, conductivity, pH control, automatic regeneration, and the use of multiport and piston-operated valves. Part II considers control of cold process softening and clarification units, hot process-hot zeolite systems and sodium zeolite systems. The article finishes with a review of panelboards, and recent developments in the field of control including silica recorders, monitors, solid state controls, and the new automatic tape analyzer. —K–81

Conveyor Elevators

A four-page color brochure describing its Hi-Lift Cable-Veyor elevators can be obtained from the Conveyor Div., Hapman Corp.

Illustrated in the brochure are two different conveyor systems of concave flights and interlocking flanges. Both are used for vertical elevation of wet or dry flowable bulk materials. Also included in the brochure are dimensional engineering drawings of installations with various receiving hopper arrangements. —K–82

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Industrial pH Amplifier

Data Sheet EIL 28 AM published by Milton Roy Co. explains and illustrates its Model 28 AM industrial pH meter, a line-connected instrument.

The miniature, non-indicating unit designed for graphic mounting provides an electrical output accurately proportional to pH. The firm says that with this output and a stability of $\pm$ 0.02 pH in 24 hr, 0.1 pH indefinitely, the instrument is suited for running most types of potentiometric or current-operated recorders or controllers. **—K-83**

Metal Finishing

Bulletin 900-P5, 24 pages, describing stamping, upset forging, rotoforming and other finishing processes is available from Commercial Shearing & Stamping Co.

Describing cost saving metal components for construction and fabricated products, machinery and equipment, transportation equipment, and missiles and rockets, the bulletin illustrates more than 50 case histories. **—K-84**

Indicating System

A remotely-located standby vertical gyro indicating system with a 2-in. wide, panel-mounted indicator is described in a two-color brochure issued by Instrument Div., Lear, Inc.

The new system is intended as a standby unit to replace an aircraft's primary indicating system in the event of a malfunction. The brochure details system characteristics and engineering data. **—K-85**

Hydraulic Shears

An eight-page bulletin describing its line of hydraulic shears has been issued by Verson Allsteel Press Co.

The shears range in capacity from 8 ft of $^3/_8$ in. mild steel to 12 ft of $1^1/_2$ in. mild steel. The bulletin shows typical models and presents specifications. Also included are descriptions and illustrations of features of design and construction. **—K-86**

Recorder, Reproducer

Digital magnetic-tape recorder/reproducer systems, made by the DataTape Div., Consolidated Electrodynamics Corp., are described in an illustrated Bulletin 1618.

The brochure describes the 5-681 digital tape recorder/reproducer transport, which operates at speeds up to 30 in. per sec, and the 5-682, a high-speed transport that operates up to 150 ips. Both are designed to meet a broad range of computer, industrial, military, and laboratory requirements. A detailed description of operating characteristics and specifications for both units are included. **—K-87**

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Aluminum Nut

A new design in aluminum self-locking nuts said to afford higher temperature, strength-to-weight, and reusability performance with more accurate torque control is described in Bulletins 3002 and 3003 by the manufacturer, Waltham Precision Instrument Co.

Called the Tru-Lok, this nut incorporates a high strength, spring temper stainless steel (18-8, FS 304) wire form in an aluminum (24ST-6) body—a combination which meets all performance requirements of MIL-N-25027 for 550 F operation as well as 250 F. —K-88

Thermal Insulation

Thermal insulations for all types of commercial and industrial requirements, in applications ranging from −400 to 3000 F, are described in a 54-page catalog, IN-244A, published by Johns-Manville.

It contains six sections, each devoted to a specialized group of thermal insulations. These include industrial and high temperature; plumbing, heating, and air conditioning; refrigeration; insulating firebrick and refractories; finishes and weatherproofing materials; and miscellaneous insulations, including asbestos papers, millboard, felts, blankets, and similar products. —K-89

Automatic Package Boilers

Tabulated data on 35 models of automatic package boilers ranging from 15 hp through 600 hp sizes is given in a four-page bulletin designated as BE-400 and published by Boiler Engineering & Supply Co.

Design specifications of the boiler itself and the integral burner system for oil, gas or combination fuels are included. Fireside and waterside circulation patterns are diagrammed. A special section deals with hot water applications for high temperature as well as normal hot water system service. Burner principles are discussed. —K-90

Manufacturing Facilities

Lake Shore, Inc., producer of large marine equipment, has announced a facilities booklet which lists its manufacturing facilities including machinery, plants, supply and services centers, sales offices, and products.

The 12-page booklet inventories the company's boring mills, planers, lathes, milling machines, drill presses, grinders, miscellaneous machine tools, shears, brakes, presses, cutters and saws, welding equipment for soft steels, stainless steel and aluminum, materials handling equipment, and other large equipment. Thirty photographs show large specialty machines in use at the company's two plants. —K-91

Flow Indicators

Condensed Bulletin M-1, published by the Instrument Div., Schutte and Koerting Co., pictures and briefly describes the division's line of precision instruments for measuring, indicating, recording, and controlling the rate of flow of all types of fluids. —K-92

Welding Pad Gages

Data Unit No. 362 gives features and specifications on Jerguson welding pad gages which can be welded right onto a tank, still, vessel, or other liquid containing structure. The units are available in either reflex or transparent types. —K-93

KEEP INFORMED

BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS

Truck Crane

A 20-page catalog, No. 732TG-2, describing the American 200 series $22^1/_2$ ton truck crane, has been released by American Hoist & Derrick Co.

On the job photographs and illustrations and descriptions of exclusive time saving features are included. **—K-94**

Belt Conveyor Scales

Bulletin No. 2M, published by Trans-Weigh Co. describes a complete line of equipment used for automatic process weighing and control and inventory weighing.

The equipment controls the flow of belt-conveyed solids in fields such as metal producing, mining, power, paper, cement, and chemical processing. **—K-95**

Gate Valve

Bulletin NP-76E on its nylon disk gate valve No. 76 is now available from OPW Jordan.

The bulletin describes and illustrates the unique nylon disks which are used as seats. The firm says the aluminum body, stainless steel stem and nylon disk seats resist a wide range of chemicals. The 3 in. valve is suitable for pressures to 75 psi and temperatures to 200 F. **—K-96**

Control Panel Design

Some important facts to be considered in designing an efficient control panel are discussed in a new four-page fact file offered by the Fuller Co.

Strategic location, good electrical and mechanical practices, codes and standards to be kept in mind, enclosures of various types, and safety precautions are covered under separate headings. Some common oversights in design are cited, as are tips on specifying a control panel. Illustrated with photographs of two different types of panels and a graphic representation of a remote control system, the bulletin also includes a list of organizations that publish codes and standards relating to control panel design. **—K-97**

Stainless Tubing

A new booklet on stainless steel tubing is now being distributed by Allegheny Ludlum Steel Corp.

The 34-page booklet gives details on the various sizes, grades, design data, corrosion resistance on both welded and seamless stainless steel tubing. More than 25 tables are included, along with photographs and other drawings and data. A special section on composite tubing is also included. **—K-98**

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Air Conditioners

An eight-page bulletin, No. 8525 describing its line of packaged air conditioners is available from American-Standard Industrial Div., Detroit 32, Mich.

The bulletin describes and illustrates design and construction features. Capacities and physical data are presented in tabular form covering both air-cooled and water-cooled designs. **—K-99**

Van Trailer Loading

A new four-page catalog, W-95, covering methods of automating loads in and out of van truck and trailer bodies by the addition of the firm's Moto-Vator powered floor conveyor kit is available from H. S. Watson Co.

Described are five different models which cover a variety of conditions, from general cargo to special pallet and unitized loads. Mixed general loads ride on moving false floor ("floor segment") models. For fleets with specialized pallet systems, three models are illustrated. **—K-100**

Soot Remover

Western Chemical Co. has issued a bulletin outlining the properties of its soot remover and fuel oil sludge dispersant as aids to better industrial fuel performance and economy.

The bulletin discusses the problems of soot removal and illustrates methods for removing it chemically. It also covers the sludge problem and shows how the firm's oil additive works to relieve it. **—K-101**

Pneumatic Conveying

A 16-page bulletin, M-588, pointing out how pneumatic conveying systems can reduce plant operating costs and improve efficiency has been issued by the Day Co.

The bulletin covers high density (fluidizing type) and low density conveying systems and equipment. Common installation arrangements are diagrammed. Photos show actual installations, basic equipment and accessories. **—K-102**

Mechanical Seals

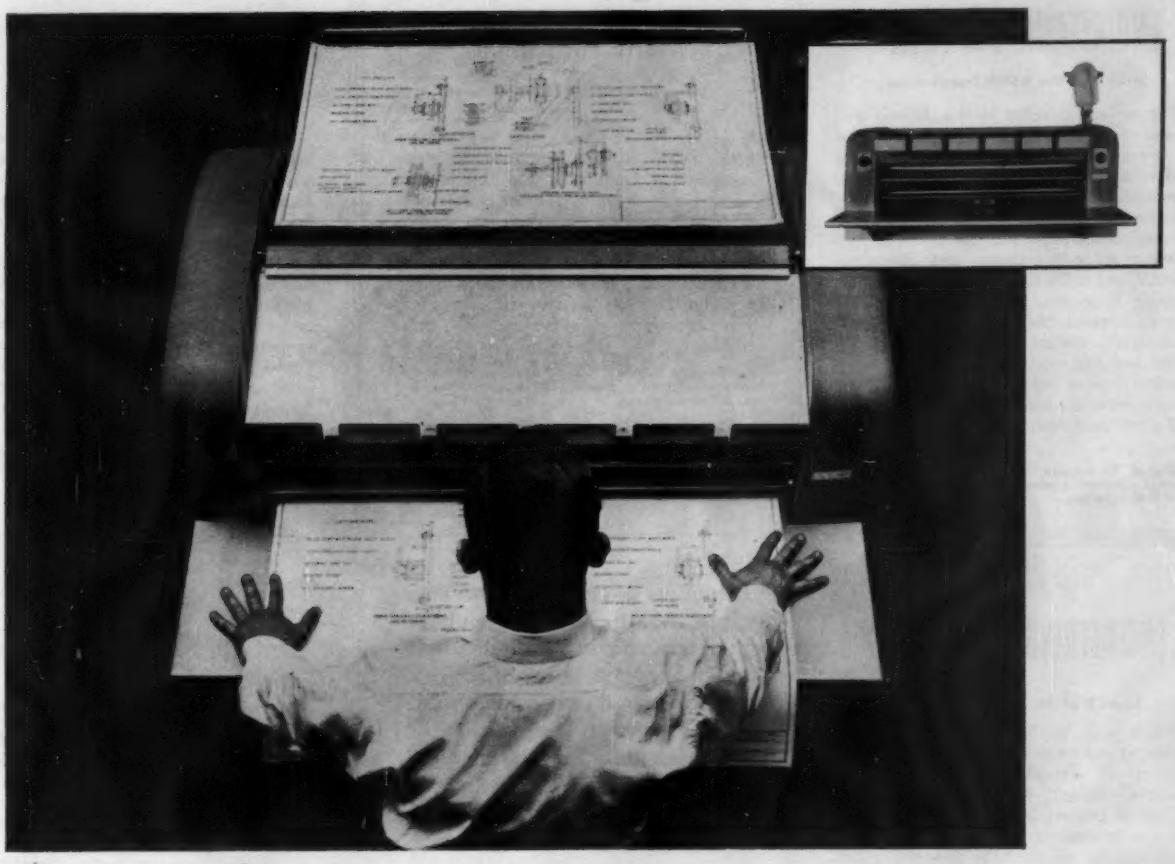
Sealol Corp. has released a four-page design data folder to facilitate the determination of frictional heat and power absorbtion for rotating mechanical seals.

The maximum permissible shaft speeds for rotating spring-type seals are given in chart form; also the PV ratings for Type RR Flexibox seals. **—K-103**

Weld Fasteners

Ohio Nut & Bolt Co., has issued a catalog giving dimensional information on its stock weld nuts, weld screws, special purpose weld parts, and leg levelers.

The catalog has been expanded to include welding information, electrode data and designs, and weld setups for welding individual parts plus illustrations and descriptions of typical applications. The 50-page book also contains an engineering section with detailed explanations of how to achieve optimum welds under various conditions. **—K-104**



Announcing . . .
Ozalid's new 30-inch
STREAMLINER 100

Now you can have a compact table-top whiteprinter with "big machine" features at a slim-budget price. And you can enjoy the convenience of on-the-spot printmaking round the clock. Make all the prints you need, inexpensively and without delay. There's no make-ready or cleanup . . . anyone can learn to use the 100 in minutes. Check these important features:

- Makes prints up to 30" wide by any length
- Front and rear print stacking
- Simple dry-developing system
- Easy turn-on, turn-off controls
- Smooth-running electronic drive with speeds up to 14 fpm
- Hook-on tracing receiving tray (optional at extra cost)

And the versatile Streamliner 100 handles the whole range of Ozalid sensitized materials . . . lets you turn out gum-backed labels, photographs, cloth maps, or color transparencies!

For complete details on the new Streamliner 100, mail coupon today!

Ozalid, Dept. U-3, Johnson City, N. Y.

Please send me free descriptive brochure on the new Streamliner 100.

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Company________________
Position________________
Street________________
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State________________

OZALID

Division of General Aniline & Film Corporation
In Canada: Hughes-Owens Co., Ltd., Montreal

TICKET TO ACHIEVEMENT

To the creative engineer, there is nothing more stimulating than to work in a creative environment. Space engineering programs now in process at Martin-Denver demand unusual creativity and may be your ticket to the personal and professional achievements which you are seeking. Make your desires and qualifications known to N. M. Pagan, Director of Technical and Scientific Staffing, The Martin Company, (Dept. 2) P. O. Box 179, Denver 1, Colorado.

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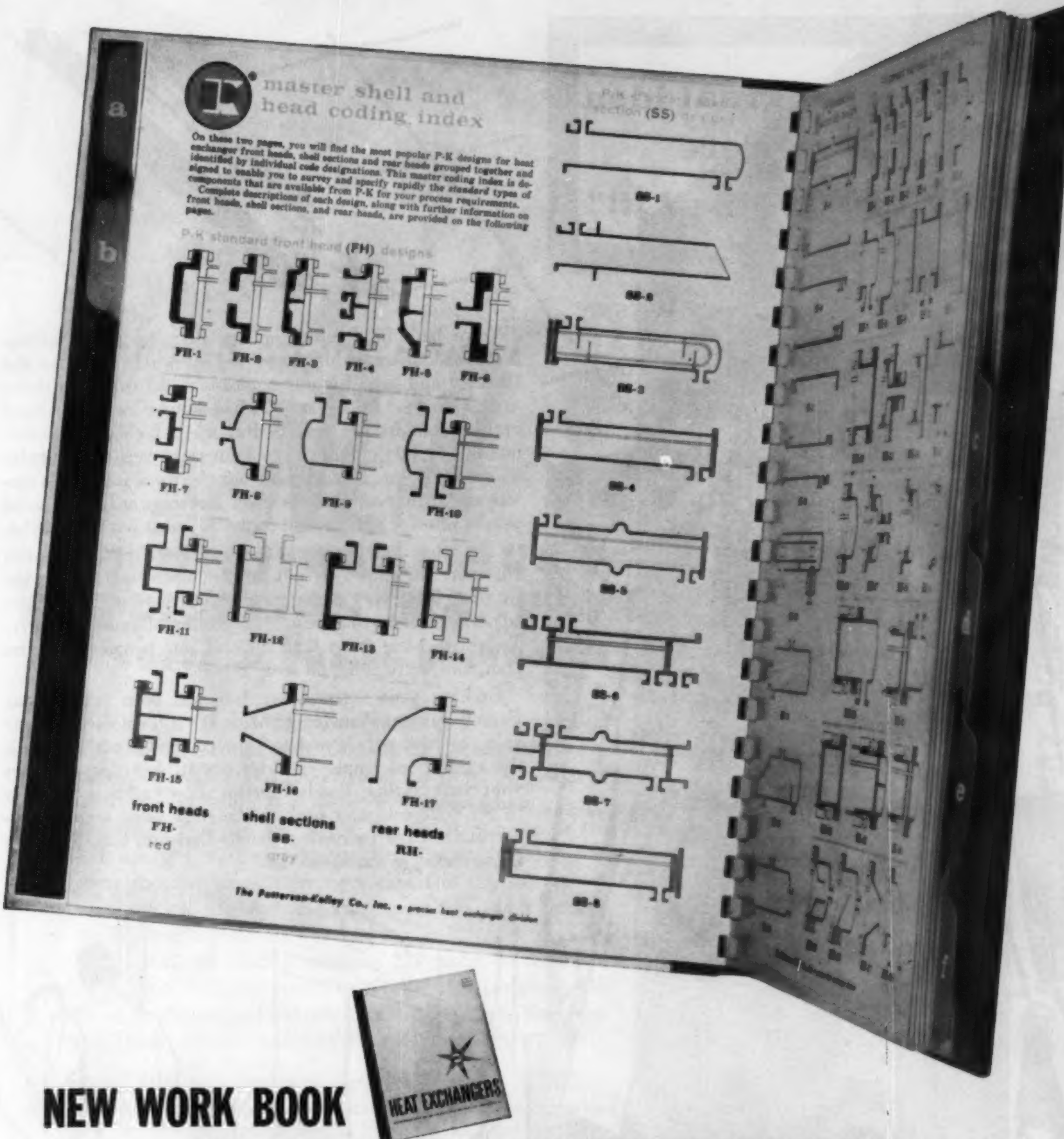
DENVER DIVISION

Martin-designed Circular Space Computers are available FREE to interested persons by writing to the same address.



a
b
master shell and head coding index
On these two pages, you will find the most popular P-K designs for heat exchanger front heads, shell sections and rear heads grouped together and identified by individual code designations. This master coding index is designed to enable you to survey and specify rapidly the standard types of components that are available from P-K for your process requirements.
Complete descriptions of each design, along with further information on front heads, shell sections, and rear heads, are provided on the following pages.
P-K standard front head (FH) designs
FH-1
FH-2
FH-3
FH-4
FH-5
FH-6
FH-7
FH-8
FH-9
FH-10
FH-11
FH-12
FH-13
FH-14
FH-15
FH-16
FH-17
front heads
FH-
red
shell sections
SS-
rear heads
RH-
section (SS)
The Patterson-Kelley Co., Inc.
HEAT EXCHANGERS

TO THE MEMBERS OF———

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

Members of the ASME are invited to name any number of engineers as candidates for membership. Engineering acquaintances should be qualified by both fundamental training and experience for one of the technical grades. Those who do not have an engineering degree may show the equivalent thereof through actual practice. Executives of attainment in science or industry may associate with the Society as Affiliates.

THE American Society of Mechanical Engineers promotes Mechanical Engineering and the allied arts and sciences, encourages original research, fosters engineering education, advances the standards of engineering, promotes the intercourse of engineers among themselves and with allied technologists; separately and in cooperation with other engineering and technical societies, and works to broaden the usefulness of the engineering profession.

As a post graduate school of engineering, the Society brings engineers into contact with each other, with leaders of thought and with new developments; it fosters the interchange of ideas, develops professional fellowships, and encourages a high standard of professional conduct—all with the purpose of advancing civilization and increasing the well-being of mankind.

O. B. Schier, II, Secretary
The American Society of Mechanical Engineers
29 West 39th Street, New York 18, N. Y.

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Please send an application and information regarding ASME to the following:

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ME-3-60

CAN YOU GUESS

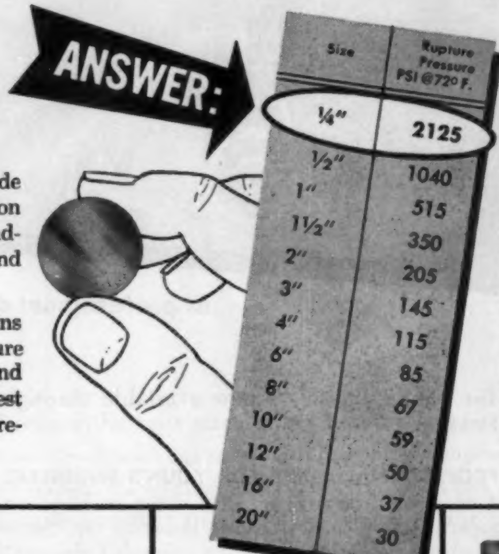
The Rupture Pressure Of A 1/4" Rupture Disc Made From This Paper-Thin Piece Of Stainless Steel By BS&B?

Rupture Disc Metals

Aluminum	Platinum	Nickel
Silver	Stainless	Monel
Copper	Inconel	

Rupture Discs are performing a wide variety of pressure relief and actuation functions on many of today's most advanced aircraft, missiles, rockets and submarines.

Here we show a few of these functions to illustrate the versatility of the rupture disc's basic principle in application and design. Perhaps one of them will suggest an answer to your pressure control requirements.

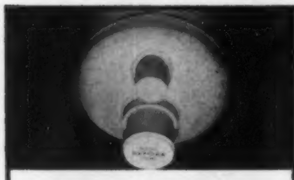


Pressure as low as 5 psi can be attained in large diameters; up to 100,000 psi in small sizes.

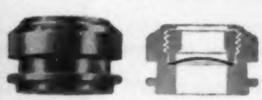
Sizes from 1/8 inch up.

Service temperatures from sub-zero up to 1000° F.

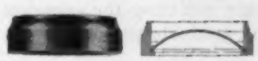
BS&B will design and fabricate any device to hold the rupture disc to your space and weight specifications.



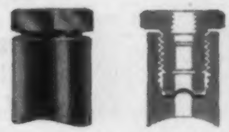
Rupture disc in larger fitting restrains the thrust of a "Jato Bottle" until the ignited propellant develops a specified pressure. When the desired thrust value pressure is reached, the disc ruptures to provide instantaneous exhaust and resultant thrust. Disc in the small fitting is a safety device for overpressure relief.



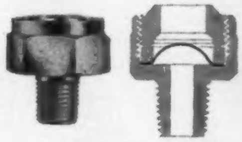
Rupture disc in this fitting is used in underwater service. At a specified pressure the disc ruptures to actuate a trigger mechanism.



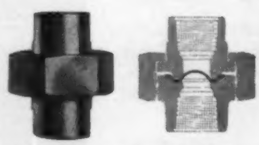
This device fits in the outer shell of a vacuum insulator vessel containing a fuel component. The rupture disc protects against dangerous pressure build-ups which might occur if the inner shell should break or leak.



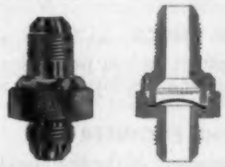
This rupture disc fitting is used on seat ejection mechanisms to lessen shock by the dissipation of excess thrust pressure.



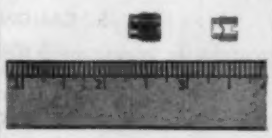
This disc assembly is used to protect against overpressure in air conditioning systems of commercial aircraft.



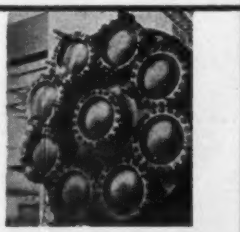
Here a rupture disc serves as a vital component in power supply of nuclear powered submarine.



Simultaneous rupture of the discs in two of these fittings triggers the mixing of a fuel and oxidizer.



Rupture disc in this tiny fitting protects against overpressure in a missile's hydraulic control system.



Large diameter (24") Safety Heads are fitted in manifold to provide overpressure protection on this engine test chamber.

May we suggest further investigation of rupture disc applicability to your pressure control requirements? For engineering consultation call or write . . .

BLACK, SIVALLS & BRYSON, INC.
Safety Head Division, Dept. 2-FQ3
7500 East 12th Street
Kansas City 26, Missouri

your first 5 years

of professional development...

A new KIT for young engineers now available through ECPD contains the following popular publications:

1. **A PROFESSIONAL GUIDE FOR YOUNG ENGINEERS . . .**
   A 48-page reference manual for young graduate engineers consisting of selected papers by William Wickenden, including the "Second Mile."

2. **YOUR FIRST FIVE YEARS . . .**
   A brochure outlining the complete six-point professional development program for young graduate engineers.

3. **SELECTED READING LIST . . .**
   A recommended reading list including natural science, philosophy, economics and sociology, psychology, business and industrial management, literature (poetry, essays, and fiction), history, biography and travel, and fine arts.

4. **PERSONAL APPRAISAL FORM . . .**
   A questionnaire to aid in evaluating professional progress and in planning for the future.

5. **CANONS OF ETHICS . . .**
   A statement of ethical principles in professional life, relations with the public, with clients and employers, and with other engineers.

6. **FAITH OF THE ENGINEER . . .**
   A brief statement of the heritage and the responsibilities of the profession.

All of the above are furnished in A CONVENIENT KIT with envelope which may become your professional development file.

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Gentlemen: Please send me ____________ First Five Years Kit(s)

for which $ ______________ is enclosed.

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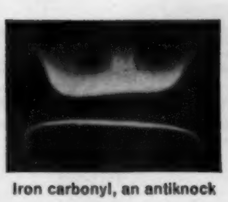
Firm ____________________

Address ____________________

City, Zone, State ____________________

Stabilized two-stage flame, no additives



Iron carbonyl, an antiknock

Ethyl nitrate, a proknock

Iron carbonyl retards, ethyl nitrate accelerates central portion of cool flames.

OPPORTUNITIES

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TOOL ENGINEER

With Manufacturing Experience in Metalworking

For application and development of metal working fluids. Experience in cutting fluids helpful. Young mechanical engineering graduate preferred. Position offers unusually attractive growth potential with nationally recognized Eastern United States oil refiner expanding into new field of activity. State background, education, experience and salary requirements

Address CA-6889, care of "Mechanical Engineering."

ENGINEERS For Uranium-Vanadium Ore Processing

Mechanical, Chemical and Extractive Metallurgical engineers with minimum 3 years' experience and outstanding record to fill production and development positions in plants located at Rifle and Uravan, Colorado. Send resume and copy of college transcript to:

Union Carbide Nuclear Company
Division of Union Carbide Corporation
P. O. Box 1049
Grand Junction, Colorado

ENGINEERS AND MATERIALS INSPECTORS WANTED

TVA has openings on a large hydro- and steam-electric program for experienced civil, structural, electrical, and mechanical engineers in its Division of Design located in Knoxville, Tennessee, and for materials engineers and inspectors of materials located in various district offices, principally in the north and east.

These positions are at the following grades and rates of pay:

Civil, Mechanical, Electrical, and Materials Engineers, grades SD-2 and -3 **$6200–$7150**

Inspectors of Materials, grades SE-5 and -6 **$5825–$6625**

The engineering jobs require a college degree in engineering or its equivalent with from one to three years of experience in design and specification work, or in inspection and testing work for materials engineers. The inspector of materials jobs require some college training in engineering or equivalent training and experience in making engineering inspection and tests of mechanical, structural, and electrical equipment and materials.

All jobs carry automatic within-grade increases for satisfactory service, liberal vacation leave, sick leave, and retirement, hospitalization, and insurance benefits.

Write to: TENNESSEE VALLEY AUTHORITY, Division of Personnel, Knoxville, Tennessee.

SPECIFICATIONS WRITER

Large engineering and construction firm engaged in central station, industrial, and chemical work has permanent staff position open for graduate mechanical engineer familiar with specifications and report writing. While many years of experience are highly desirable, your merit will be given full consideration.

Salary commensurate with experience and ability. Excellent working conditions and liberal company benefits.

Applicants please submit full details including personal data, education, experience and salary desired in your reply.

Address CA-6877, care of "Mechanical Engineering."

RAILROAD CAR DESIGNER

Large fast growing tank car firm, with offices in Chicago Loop, seeks a graduate engineer with experience in R.R. tank car, freight car, or component design.

If you want responsibility along with individual recognition, please contact us.

Please submit detailed resume, stating salary desired.

Address CA-6897, care of "Mechanical Engineering."

Project Engineers Design Engineers Instrument Engineers Equipment Engineers

Career opportunities with leading, fastest-growing, engineer-constructors polymer, plastics, rubber plants. Experience with operating or contracting company in polymers, plastics or rubber. Pleasant suburban living. All benefits. Please send us resume in complete confidence.

CRAWFORD & RUSSELL
Incorporated
695 Summer Street
Stamford, Connecticut

PROJECT ENGINEERS

Established Philadelphia engineering and construction firm has permanent staff positions open for graduate mechanical engineers with 5 years' minimum experience as Project Engineers in design of steam electric power stations involving project inter-office and client coordination. Salary will be commensurate with experience and ability. Excellent working conditions and liberal company benefits.

Please give full details including personal data, education, experience, references, and salary requirements in your reply.

Address CA-6876, care of "Mechanical Engineering."

Opportunities open at . . . .

Fairbanks, Morse & Co.

In our new and rapidly expanding . . . .

COMPRESSOR DIVISION

The expansion of activities in this new product division has created challenging openings in several areas. . . .

Project and Product Engineering • Development Engineering • Layout & Detail Drafting • Application Engineering • Field Sales Engineering

We welcome replies from individuals having applicable experience and education. Replies will be handled on a confidential basis. Write to:

Attention: Compressor Division

FAIRBANKS, MORSE & CO.
600 S. MICHIGAN AVENUE
CHICAGO 5, ILLINOIS

A MAJOR INDUSTRIAL COMPONENT OF FAIRBANKS WHITNEY CORPORATION

The new Mechanical R&D Laboratory is situated within the boundaries of Stamford, Connecticut—minutes from Long Island Sound, under one hour from New York City.

AMF Announces Spring Opening of its new Mechanical R&D Laboratory

Intensified Programs Advance AMF's 60-Year Record of Revolutionary Breakthroughs in Industrial Systems

Steps forward in industrial systems become giant strides when creative engineers strive for revolutionary concepts beyond the bounds of accepted technology.

At AMF's new Mechanical R&D Laboratory, engineers leave cobwebbed ideas at the door and let their imaginations soar . . . to create radically new automated electromechanical systems for industry—systems that will completely eliminate all manual operations between receipt of raw materials and packaging of finished product.

Freedom to think and do—and *tangible* acknowledgement of contributions—are the boons to capable senior engineers at AMF. The positions are worth your serious consideration. There are immediate openings in the following areas:

AUTOMATIC MACHINERY

M/ME or equivalent with minimum 7 years experience in the design and development of automatic machinery. Will direct complete projects from the original concept stage up through fabrication and testing, including coordination of associated research and preparation of specifications, studies and technical reports.

HYDRAULICS AND FLUID FLOW

Degree engineer with 7-10 years in the design and development of fluid flow, hydraulics, and pneumatic equipment. Must be imaginative with a well-developed ability to conceptualize.

MECHANISMS

M/ME with 5-7 years or BS/ME with 10 years experience in the field of small mechanisms, automatic mechanical apparatus, and electromechanical devices. Background should include design, fabrication and testing—and must have project engineering experience of increasing complexity.

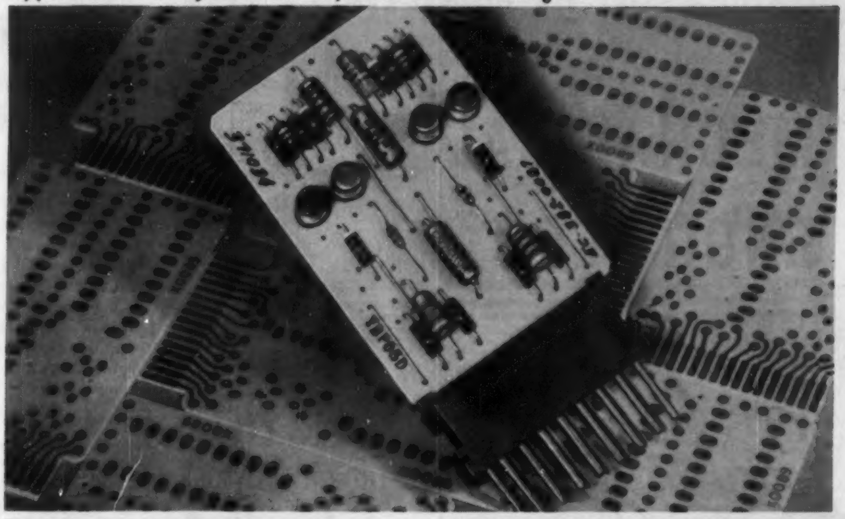
Please send your confidential inquiry to Paul Luke, Personnel Administrator
Mechanical R&D Laboratory • RESEARCH & DEVELOPMENT DIVISION

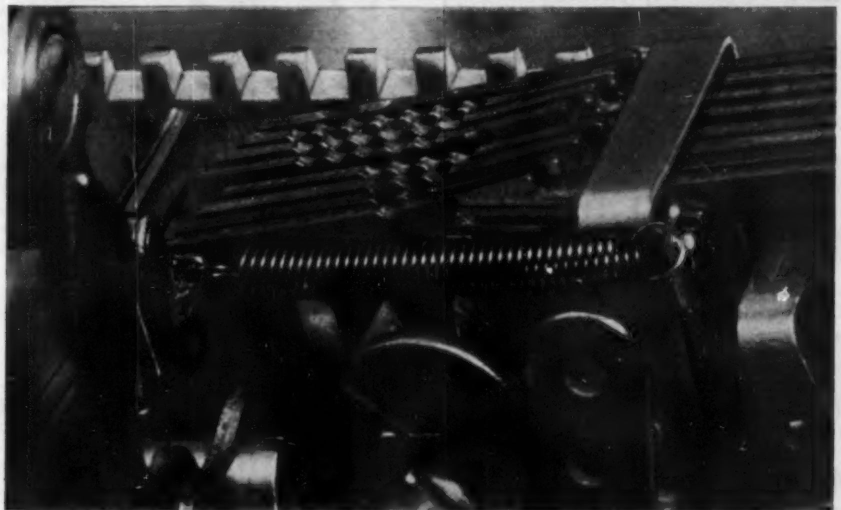
AMERICAN MACHINE & FOUNDRY COMPANY

689 HOPE STREET • SPRINGDALE, CONNECTICUT

MECHANICAL ENGINEERING
February, 1960 CARD INDEX Vol. 82, No. 2

Opportunities in systems development at IBM Lexington





Top, printed circuit card and guide for logic devices. Bottom, a proportional escapement mechanism.

Applying new technologies in radically different systems

At IBM's Engineering Laboratory in Lexington, Kentucky, radically different business systems are under development. Designed for companies not able to utilize large-scale business equipment, these new electronic and electromechanical business machines incorporate many recent technological achievements. For instance . . .

- Based on new findings in noise generation and attenuation, machine parts are being designed which significantly reduce operating noise.
- In logical circuit design, several recent solid state advances have been adopted. These are expected to extend the flexibility and life of small business machines.
- Also under study are new techniques involving photoconductivity, parametric amplifiers, magnetic cores, tunnel diodes, and transistors. The purpose: design of new types of low-cost switching devices, binary adders, and memory units.

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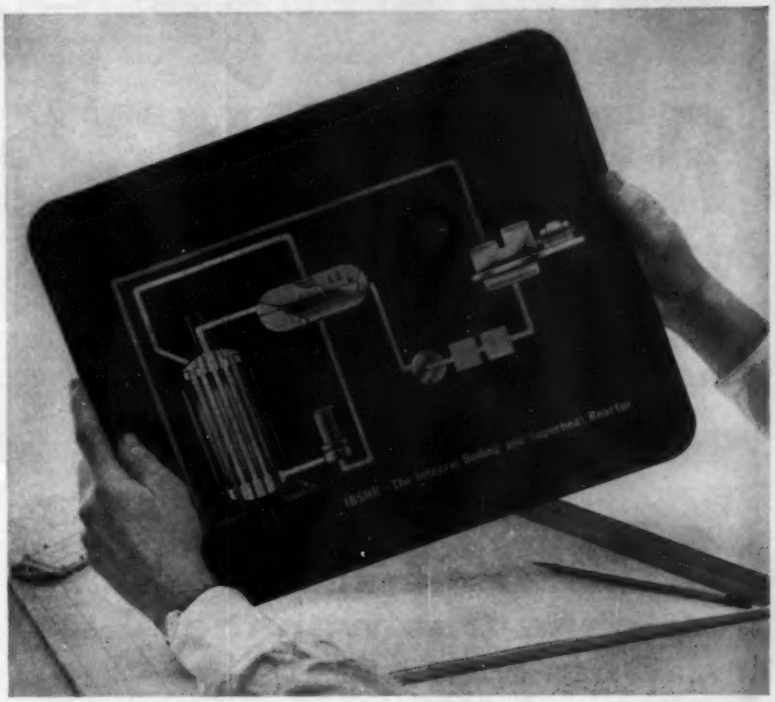

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